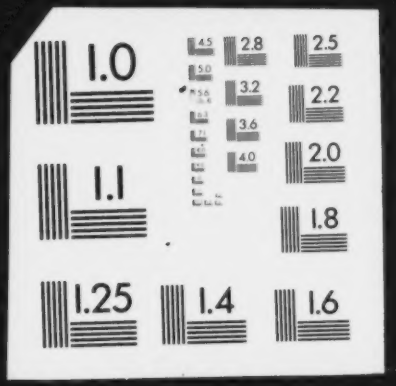
1.0
1.1
1.25
1.4
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3.2
3.6
4.0
2.5
2.2
2.0
1.8

Senior 4 Applied Mathematics (40S)
Standards Test

Written Test

June 2005

Manitoba

Building for the Future

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106-03456/

SENIOR 4 APPLIED MATHEMATICS (40S)
STANDARDS TEST

DESCRIPTION

Total Possible Marks: 53 **Time: 2.5 hours**

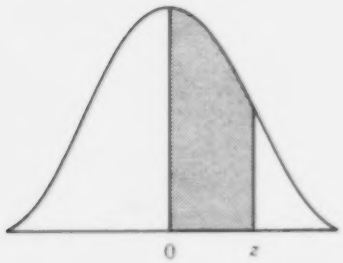
This test consists of two sections:

	Description	Suggested Time to Complete	Marks
Section A	9 selected-response questions worth 1 mark each	20 minutes	9
Section B	14 constructed-response questions worth from 2 to 5 marks each	130 minutes	44

TEST RESOURCES AND DIRECTIONS

- You are provided with the Standard Normal Distribution table (see page 2).
- You may consult your 8½" × 11" individually prepared study sheet during the test.
- Use of a graphing calculator, computer software or a Website is allowed.
- Use of protractor and ruler are allowed.
- Read all instructions on the test carefully.
- In Section A, choose the best response and mark it on the *Answer/Scoring Sheet*. Do not fold the *Answer/Scoring Sheet* or the test booklet.
- If you need more space to answer a question, extra pages may be provided by your teacher. Write your booklet ID number and question number on any extra page(s) used and staple it into the booklet where your answer begins. Indicate in the response space of the question that the answer is on a separate sheet.

z-Score Chart



Notes:

1. For values of z above 3.09, use 0.4999 for the area.
2. Use these common values that result from interpolation:

z-score	area
1.645	0.4500
2.575	0.4950

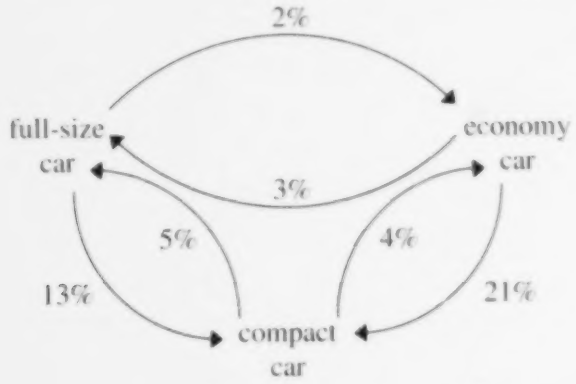
The Standard Normal (z) Distribution

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990

SECTION A: SELECTED-RESPONSE QUESTIONS

Value: 9 marks **Suggested Time: 20 minutes**

1. The diagram below illustrates the changes in the types of cars chosen by Canadian consumers. Which 3×3 transition matrix represents this switching behaviour?



A)
$$\begin{array}{c} \\ \text{f} \\ \text{c} \\ \text{e} \end{array}\begin{array}{c} \begin{array}{ccc} \text{f} & \text{c} & \text{e} \end{array} \\ \begin{bmatrix} 85 & 13 & 2 \\ 5 & 91 & 4 \\ 3 & 21 & 76 \end{bmatrix} \end{array}$$

B)
$$\begin{array}{c} \\ \text{f} \\ \text{c} \\ \text{e} \end{array}\begin{array}{c} \begin{array}{ccc} \text{f} & \text{c} & \text{e} \end{array} \\ \begin{bmatrix} 0.85 & 0.13 & 0.02 \\ 0.05 & 0.91 & 0.04 \\ 0.03 & 0.21 & 0.76 \end{bmatrix} \end{array}$$

C)
$$\begin{array}{c} \\ \text{f} \\ \text{c} \\ \text{e} \end{array}\begin{array}{c} \begin{array}{ccc} \text{f} & \text{c} & \text{e} \end{array} \\ \begin{bmatrix} 0.85 & 0.05 & 0.03 \\ 0.13 & 0.91 & 0.21 \\ 0.02 & 0.04 & 0.76 \end{bmatrix} \end{array}$$

D)
$$\begin{array}{c} \\ \text{f} \\ \text{c} \\ \text{e} \end{array}\begin{array}{c} \begin{array}{ccc} \text{f} & \text{c} & \text{e} \end{array} \\ \begin{bmatrix} 0.00 & 0.13 & 0.02 \\ 0.05 & 0.00 & 0.04 \\ 0.03 & 0.21 & 0.00 \end{bmatrix} \end{array}$$

2. When you multiply matrix $A = \begin{bmatrix} 1 & 1 & 1 & 1 \end{bmatrix}$ by a 4×4 matrix B, the product AB is:

A) a 4×4 matrix identical to matrix B

B) a 1×4 matrix whose values are the sum of each row of matrix B

C) a 1×4 matrix whose values are the sum of each column of matrix B

D) a 4×1 matrix whose values are the product of each column of matrix B

3. The following vector diagram represents a car travelling at 60 km/h. Determine the scale and direction of this vector.

A) 1 cm: 4 km/h, SE

B) 1 cm: 15 km/h, SE

C) 1 cm: 4 km/h, SW

D) 1 cm: 15 km/h, SW

4. You jog 300 m east and then 400 m north. If you were to run straight back to your starting point, in which direction would you head?

A) S 53° W

B) 53° north of east

C) at a bearing of 37°

D) at a bearing of 217°

5. Which of the following is considered income on an income tax return?

A) tips and gratuities

B) medical expenses

C) charitable donations

D) contributions made to an RRSP

6. A house is valued at $120 000.00. It appreciates at a rate of 3% per year. Determine the expected value of the house after five years to the nearest hundred dollars.

A) $103 100.00

B) $123 600.00

C) $138 000.00

D) $139 100.00

7. In how many different ways can the letters of the word WAWANESA be arranged?

A) 8

B) 3360

C) 13 440

D) 40 320

8. Two 6-sided cubes whose faces are numbered 1 to 6 are rolled. The probability that their sum is less than 5 is:

A) $\frac{1}{6}$

B) $\frac{1}{5}$

C) $\frac{1}{2}$

D) $\frac{5}{6}$

9. The scores of the Standford-Binet IQ (Intelligence Quotient) test are normally distributed with a mean of 100 and a standard deviation of 16. According to this test, what is the probability that a randomly selected Canadian will have an IQ between 84 and 116?

A) 0.16

B) 0.34

C) 0.50

D) 0.68

SECTION B: CONSTRUCTED-RESPONSE QUESTIONS

Value: 44 marks **Suggested Time: 130 minutes**

DIRECTIONS

- There are 14 constructed-response questions in this section of the test. Each question is worth from 2 to 5 marks.
- Provide **complete answers** in the spaces provided in the test booklet. You may print out sketches from the computer or your calculator where applicable. Make sure these printouts contain your booklet ID number. Remain seated and your teacher will distribute these printouts to you. Staple the printouts in the booklet where the question begins. Indicate in the response space of the question that the answer is on a printed sheet.
- Provide clear explanations or justifications where applicable. This could be done through labelled diagrams, in words, by showing mathematical operations to verify your answer, or by referencing a software or a calculator program.
  - If you reference a calculator program, indicate your input values.
  - If you reference a spreadsheet, print a copy of the formulas and a copy of the answers.
  - If you reference a software program or a Website, indicate your input values and print or copy the screen showing answers.
- Let the mark values for each question guide your time and the amount of detail you use in your answer. Mark values for subsections of a question are indicated in parentheses.
- Round your final answers to the nearest two decimal places.
- Unless otherwise specified, it is not necessary to draw sketches to scale. If you draw a scale diagram, make sure you indicate your scale.
- An answer without any work shown will be considered incomplete.
- Always state your assumptions.

DO NOT USE

101

10. An organization of snowmobilers has formed the following network of trails:

Total: 3 marks

- Each town has a local trail that begins and ends in its own town.
- One direct route from Belmont to Glenboro.
- One direct route from Treesbank to Stockton.
- One direct route from Treesbank to Belmont.
- One direct route from Glenboro to Belmont.
- One direct route from Stockton to each of the following towns: Treesbank, Belmont and Glenboro.

a) Draw the network diagram.

(1 mark)

Belmont Treesbank

Glenboro Stockton

b) Create matrix A to represent this network of trails.

(1 mark)

$$A = \text{(From)} \begin{matrix} \\ B \\ G \\ S \\ T \end{matrix} \begin{matrix} \text{(To)} \\ B & G & S & T \end{matrix} \begin{bmatrix} & & & \\ & & & \\ & & & \\ & & & \end{bmatrix}$$

c) Show the matrix operations to calculate the number of trails from one town to another passing through at most two other towns. Do not solve.

(1 mark)

DO NOT USE

102

11. A chain of music stores had the following weekly sales in its three Manitoba stores:

Total: 4 marks

	Winnipeg	Brandon	Dauphin
T-shirt	173	57	16
CD	780	289	67
DVD	470	163	45
Poster	302	94	27

The following chart shows the cost to customers and the cost to stores for each item.

	T-shirt	CD	DVD	Poster
Cost to customers	$19.95	$18.95	$24.95	$4.99
Cost to stores	$5.10	$4.50	$7.25	$1.15

a) Use matrix operations to calculate the GST on the weekly sales from each store. Show your work and indicate your answer in matrix form.

(2 marks)

b) Use matrix operations to calculate the weekly profit from each store. Show your work and indicate your answer in matrix form.

(2 marks)

DO NOT USE

103

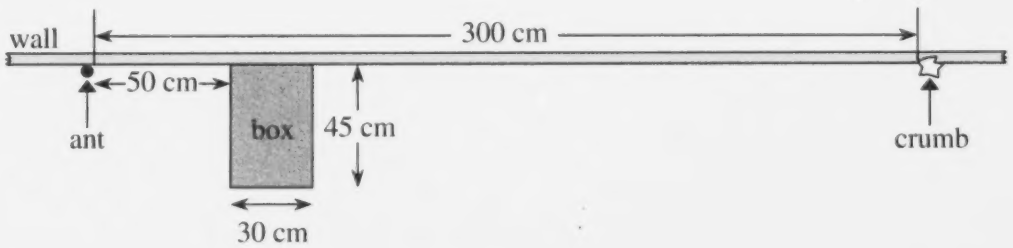
12. A hungry ant has a problem. A crumb from a sandwich has fallen to the ground 3 metres east of the ant. The ant wants to eat the crumb but a 30 cm × 45 cm box has been pushed tightly against the wall and is in its path.

Total: 5 marks

a) Using the given diagram, sketch a vector diagram and calculate the shortest route along the ground that the ant can take to reach the crumb. Diagram is not drawn to scale.

(2 marks)

Top View

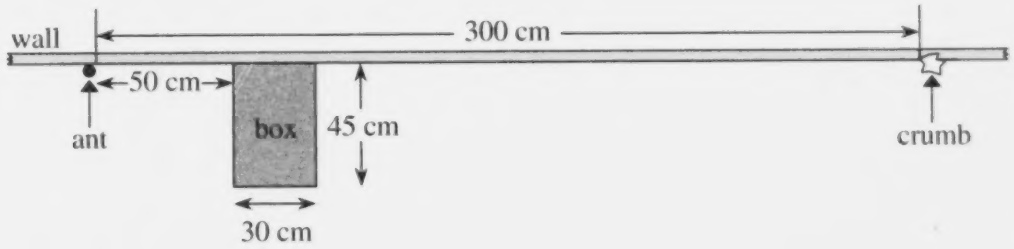


DO NOT USE

b) Using only two vectors, sketch another route along the ground that the ant can take to reach the crumb. The ant can travel at 0.50 cm/s. Determine the distance the ant must travel and the length of time needed to get to the crumb. Indicate your strategy.

(3 marks)

Top View



DO NOT USE

103

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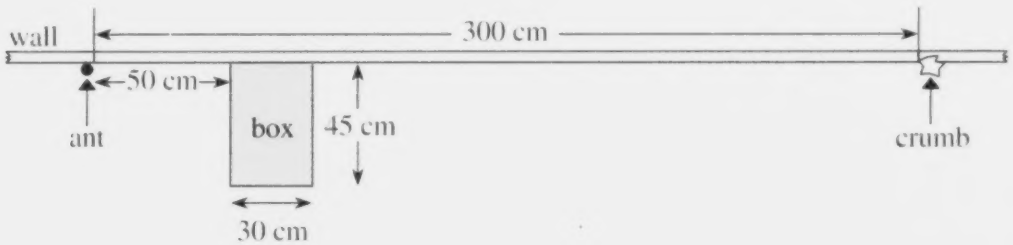
(2 marks)

Top View



DO NOT USE

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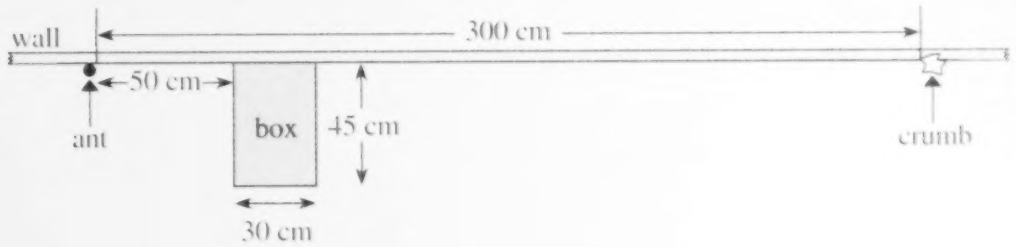
(3 marks)

Top View



DO NOT USE

13. Charles and his brother François are playing a game of "water bombers" with water balloons in a corn maze. Charles remains at the entrance of the maze while François walks 12 metres west and then 10 metres northeast. 104

In what direction should Charles throw his water balloon in order to hit his brother? Indicate your strategy.

Total: 2 marks

DO NOT USE

105

14. The Coopers buy a condominium for $100 000.00 with a down payment of $20 000.00. The mortgage is amortized over 25 years at an interest rate of 6.50% compounded monthly.

Total: 4 marks

a) What will their monthly mortgage payment be?

(2 marks)

b) Determine the amount left owing on the mortgage and the amount of interest the Coopers will have paid at the end of 10 years.

(2 marks)

DO NOT USE

106

15. Carl wants to buy or lease a car. The purchase price is $31 920.00 including taxes. Carl has a down payment of $2000.00 to purchase or lease the car. The finance rate is 4.50% compounded monthly.

Total: 4 marks

a) Calculate Carl's monthly payment if he purchases the car and finances it over a period of 5 years.

(2 marks)

b) Carl can lease the car for $375.00 a month (including taxes) for a period of 48 months. After this time, the residual value of the car is 40% of the original purchase price of $31 920.00. Calculate the total price including the down payment of $2000.00 and the lease payments to purchase the car at the end of the lease. Indicate your strategy.

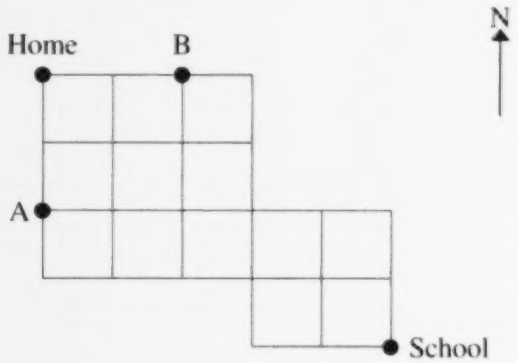
(2 marks)

DO NOT USE

16. James must go to the grocery store on his way home from school. He must travel north or west along the streets indicated in the diagram below. He thinks that there are more ways to get home if he stops at grocery store A. His mother thinks that there are more ways to get home by stopping at grocery store B. Explain who is correct. Support your answer.

107

Total: 2 marks



DO NOT USE

17. Manitoba licence plates are made up of 3 letters followed by a 3-digit number.

How many licence plates can be made if the third letter must be an E and the 3-digit number must be greater than or equal to 300? Indicate your strategy.

108

Total:
2 marks

DO NOT USE

18. A quiz is made up of 4 true or false questions. Determine the probability that you will have at least one correct answer if you guessed the answers to all 4 questions. Indicate your strategy.

109

Total: 2 marks

DO NOT USE

110

19. The following data represents the points the Winnipeg Blue Bombers scored in each game during their 2003 football season:

Total: 2 marks

15	39	54	27	21	37	18	22
19	26	48	31	22	35	51	42

a) Find the population standard deviation for the football scores. Round your answer to two decimal places.

(1 mark)

b) The mean score for the 2003 season was 31.69. What is the z-score for the football game in which the team scored 39 points?

(1 mark)

DO NOT USE

111

20. The height of adult females in Canada is normally distributed with a mean of 164 cm and a standard deviation of 4.10 cm.

Total: 4 marks

a) Prior to 1985, the Winnipeg Police Service considered a height of 157 cm or less to be too short for women to join the police service. What percentage of adult females would have been too short to join the police force at that time? Indicate your strategy.

(2 marks)

b) At that time, approximately 11.10% of adult females were too short to enlist in the Brandon Police Service. What minimum height was being used in the Brandon Police Service selection process? Indicate your strategy.

(2 marks)

DO NOT USE

112

21. RCMP statistics show that there is a 15% probability that a motorist is speeding on the highway at Headingley.

Total: 3 marks

a) Determine a 95% confidence interv: for the mean number of motorists who speed each day if 10 000 cars travel this highway daily. Indicate your strategy.

(2 marks)

b) Explain what the confidence interval means in this situation.

(1 mark)

DO NOT USE

113

22. For several hundred years, astronomers have kept track of the sinusoidal behaviour of solar flares, or sunspots, which occur on the surface of the sun. The number of sunspots counted in a given year varies from a minimum of 10 to a maximum of 110. Between the maximums that occurred in the years 1732 and 1948, there were 18 complete cycles.

Total: 3 marks

a) What is the period for one sunspot cycle?

(1 mark)

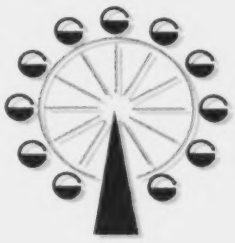
b) Write a sinusoidal equation that represents this cycle of sunspots.

(2 marks)

23. You have been asked to design a Ferris wheel with the following parameters:

Total: 4 marks

- The diameter must be between 20 m and 40 m (inclusive).
- The number of rotations per minute must be between 4 and 8 (inclusive).
- There must be at least 1 m between the bottom of the Ferris wheel and the ground.



State your Ferris wheel dimensions:

diameter = _____

rotations per minute = _____

ground clearance = _____

a) Draw a graph showing one full rotation for a passenger on your Ferris wheel. Your graph must show the period as well as the maximum and minimum heights.

(2 marks)

b) Using your graph, determine the sinusoidal equation that represents the motion of a passenger once they have reached a constant speed.

(2 marks)

END OF TEST

NO MARKS WILL BE AWARDED FOR WORK DONE ON THIS PAGE.

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Senior 4 Applied Mathematics (40S)
Standards Test

Inquiry Task

June 2005

Manitoba

Building for the Future

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SENIOR 4 APPLIED MATHEMATICS (40S)
STANDARDS TEST

DESCRIPTION

Total Possible Marks: 18 **Time: 2 hours**

This test consists of two tasks:

	Description	Suggested Time to Complete	Marks
Task 1	Contains a question on Design and Measurement worth 8 marks	60 minutes	8
Task 2	Contains a question on Sequences worth 10 marks	60 minutes	10

TEST RESOURCES AND DIRECTIONS

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- If you use a spreadsheet, make sure you print two copies of your spreadsheets, one showing the answers and one showing the formulas. Indicate your booklet ID number on each printout. Remain seated and your teacher will distribute these printouts to you.
- If you use a Website, make sure you indicate all the values you entered, and print or copy the screen, showing answers.
- Please staple printed copies of all your work on the page of the question. Indicate in the response space of the question that the answer is on a printed sheet.
- Clearly identify the question number on your answer sheet(s) (e.g., Question 2b).
- Always state your assumptions.

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- You may consult your 8½" × 11" individually prepared study sheet during the test.
- If you use a graphing calculator, make sure you indicate all the values you entered in the space provided in this booklet.
- If you use a spreadsheet, make sure you print two copies of your spreadsheets, one showing the answers and one showing the formulas. Indicate your booklet ID number on each printout. Remain seated and your teacher will distribute these printouts to you.
- If you use a Website, make sure you indicate all the values you entered, and print or copy the screen, showing answers.
- Please staple printed copies of all your work on the page of the question. Indicate in the response space of the question that the answer is on a printed sheet.
- Clearly identify the question number on your answer sheet(s) (e.g., Question 2b).
- Always state your assumptions.

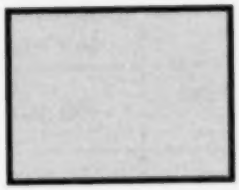
DO NOT USE

115

DESIGN AND MEASUREMENT

1. Linda has prepared two cakes. One is in a rectangular pan that measures 9 inches by 13 inches, with a depth of 3 inches. The other is in a circular tube pan which is 12 inches in diameter and 5.50 inches deep. The circular pan which has a cylinder in the centre produces a round cake with a 3-inch diameter hole in the centre.

Total: 8 marks



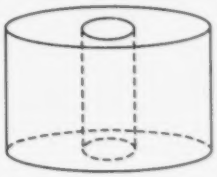
a) Linda wants to use the rectangular cake for a birthday party. She needs to cut 5 large pieces (4" × 3") and at least 12 small pieces (2" × 2") for her guests (whole pieces only). Does she have enough cake for her guests? Support your answer with a scale drawing.

(2 marks)

DO NOT USE

b) Linda wants to calculate the cost of making and decorating the circular cake. She will put a uniform layer of icing on the outside and inside walls, and the top of the cake. For decoration, a chocolate string will go on the top circumference of her cake, including enough to go around the centre opening. Calculate the total cost to make and decorate Linda's cake. Show your work.

Batter	\$0.004 per $in.^3$
Icing	\$0.01 per $in.^2$ (uniform layer)
Chocolate string	\$0.39 per ft. (sold in one foot lengths)



(6 marks)

DO NOT USE

116

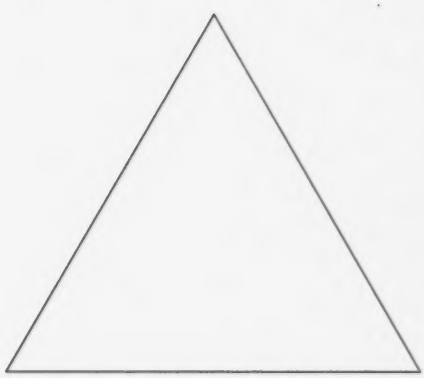
SEQUENCES

2. Create a fractal using the outside of the equilateral triangle below. Your fractal must always be created on the outside of the previous iteration.

Total: 10 marks

a) Draw your fractal to the 3rd iteration (inclusive) on the original shown below.

(2 marks)



DO NOT USE

b) Write specific directions to draw your fractal pattern.

(2 marks)

c) Complete the table for the first 4 iterations of your fractal. Assume that the original triangle has sides of length 6 cm.

(3 marks)

	Number of sides	Length of each side	Total Perimeter
original triangle	3	6 cm	18 cm

Iteration	Number of new sides	Length of each new side	Total Perimeter
1			
2			
3			
4			

DO NOT USE

d) What would the total perimeter of your fractal be after 6 iterations?

(1 mark)

e) What would happen to the perimeter of the fractal if the number of iterations increased indefinitely? Support your answer.

(2 marks)

END OF TEST

NO MARKS WILL BE AWARDED FOR WORK DONE ON THIS PAGE.

NO MARKS WILL BE AWARDED FOR WORK DONE ON THIS PAGE.

Manitoba

IMPORTANT

ERRATA

Please note the following changes in the *Marking Guide*:

Question 21

Page 30—Please disregard this marker note as it is not relevant to this question.

Page 32—Please replace the mark rationale for this exemplar with the following:

2 marks:

- 1 mark for work shown indicating an appropriate strategy in a)
- 1 mark for correct answer in a)

Inquiry 1

Page 46—Please add the following marker note to part a) of this exemplar:

Marker Note:

- *Student's original work is to scale.*

Inquiry 2

Page 65—Please replace the mark rationale for this exemplar with the following:

3 marks:

- 1 mark for drawing a fractal on the outside of the original triangle in a)
- 1 mark for total perimeter of fractal after 6 iterations in d) consistent with error in c)
- 1 mark for correct answer in e)

Senior 4 Applied Mathematics (40S)
Standards Test

Marking Guide

June 2005

Manitoba

Building for the Future

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Manitoba Education, Citizenship and Youth,
Instruction, Curriculum and Assessment Branch,
Winnipeg, Manitoba R3E 3J5

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General Instructions

Organization of Document

Following the general instructions for marking, the document is divided into three sections:

- Answer key for selected-response items;
- Marking keys and scoring rubrics for constructed-response items; and
- Marking keys and scoring rubrics for the Inquiry Task.

The first section presents the answers for the selected-response items in a table accompanied by the learning outcome(s) associated with each item. In the second section, each test item is presented in bold characters, followed by a series of typical and possible answers. A marking key or scoring rubric details how the marks are to be allocated for each sub-section of the question. Marking keys are used to mark restricted-response items (with or without explanations). Scoring rubrics are to be used for scoring open-response items.

For each question, the item type, the maximum number of marks possible as well as the specific outcomes targeted by the item are identified at the top of the page. Items are presented in the order that they appear on the standards test. Each open-response item as well as each Inquiry Task item is followed by a series of student exemplars. Student exemplars are chosen to exemplify the use of scoring rubrics or marking keys. The mark value allocated and a rationale justifying the mark allocation accompany each student exemplar.

General Marking Instructions

Please make no marks in the test booklets.

Please ensure that:

- each student's final result is recorded, by test booklet number, on the corresponding ***Answer/Scoring Sheet*** (Written Test) and ***Scoring Sheet*** (Inquiry Task);
- the totals are written at the bottom;
- the *Answer/Scoring Sheet* and *Scoring Sheet* are complete and correct;
- a copy has been made for school records; and
- **only a pencil is used to complete the *Answer/Scoring Sheets* and *Scoring Sheets*, by both students and markers.**

Once marking is completed, please forward the *Answer/Scoring Sheets* and *Scoring Sheets* to Manitoba Education, Citizenship and Youth (for more information see the *Administration Manual for Supervising Teachers*).

Scoring the Selected-Response Items

Please follow the answer key provided on page 5 of this document.

Types of Student Errors

As a guiding principle, students should only be penalized once for each error committed in the context of a test item. For example, students may choose an inappropriate but still relevant strategy for an item but carry it through correctly and arrive at an incorrect answer. In such cases, students should be penalized for having selected an inappropriate strategy for the task at hand but should be given credit for having arrived at an answer consistent with their choice of strategy.

Please note that for all questions in the vectors unit, allow a flexibility of ±3 mm and ±3° when marking scale diagrams.

Throughout this document, four types of errors have been identified. These are defined briefly below:

Trivial errors:
These are errors for which no marks are to be deducted. In order to be considered trivial, an error must be conceptually unrelated to the learning outcome(s) associated with the item and not lead to a mathematically incorrect answer. Examples include omitting labels, omitting to carry a negative sign in an algebraic task or not rounding final answers.

Technical communication errors:
These are errors of mathematical notation that are conceptually related to the curriculum outcomes. It is important to note, however, that such errors do not prevent students from arriving at a mathematically correct answer.

Examples include:

- incorrect use of brackets on matrices;
- not expressing transition matrices as decimals or percentages;
- missing more than one arrow in a vector diagram;
- not stating a scale when using a scale diagram as a strategy;
- not buying in whole units in the design and measurement unit; and
- "y =" missing when asked for an equation.

In such cases, students are to be penalized no more than a half mark per question for each type of error, and only when the corresponding criteria are awarded.

Minor errors:
These are errors that are generally not conceptual in nature but will inevitably lead to an incorrect answer. In such cases, students are generally penalized one mark depending on the details provided in the marking key or scoring rubric.

Major errors:
These are errors or omissions that are conceptual in nature and clearly reflect a gap in the student's knowledge of the specific learning outcome(s). These types of errors often limit the number of marks that can be awarded to a student's response.

Scoring the Constructed-Response Items

The respective marking key or scoring rubric should be used in conjunction with the ***Senior 4 Mathematics: Manitoba Curriculum Framework of Outcomes and Senior 4 Standards*** (Applied section) when assigning scores to student responses.

Scoring guidelines—Restricted-response items (with or without explanation)

Each item of this type is designed to elicit a well-defined response according to the associated specific outcome(s) and relevant mathematical processes. Their purpose is to determine whether a student meets the standards for the course (level 2) as they relate to the knowledge and skills associated with the item.

To receive full marks, a student's response must be complete and correct. Partial marks may be awarded for a "relevant strategy" with execution errors. **A relevant strategy is defined as one that is consistent with the specific outcome(s) and mathematical processes associated with the item that, if properly executed, would lead to the correct answer.** Where alternative strategies are possible, the marking key makes mention of them.

It is important to note that some items require some form of explanation or justification from students. Such explanations and justifications can take various forms depending on students' learning styles. Therefore, marking of student responses needs to reflect appropriate flexibility in this regard. Test instructions to students have clearly specified that explanations or justifications can be done through labelled diagrams, in words, by showing mathematical operations for answer verification or by referencing software or a calculator program.

Scoring guidelines—Open-response items

These items are designed to elicit student responses at any of the three levels of achievement defined in the *Senior 4 Mathematics: Manitoba Curriculum Framework of Outcomes and Senior 4 Standards* (Applied section). The rubrics contain the language of the curricular standards in order to facilitate scoring in a manner that is consistent with those standards. The recommended procedure for scoring student responses is as follows:

1. Read the relevant specific outcome(s) in the *Senior 4 Mathematics: Manitoba Curriculum Framework of Outcomes and Senior 4 Standards* (Applied section).

2. Read the possible solution(s) provided in this document.

3. Study the student exemplars provided and the rationales for the assigned scores in relation to the marking key.

4. Carefully view all of the student's response and decide which of the three levels of achievement ("exceptional understanding", "good understanding" or "limited understanding") best applies. Whether the response clearly fits into one category or straddles two, this process will narrow down the number of possible scores that can be assigned to the response.

5. Compare the features of the student's response with the general performance indicators accompanying the mark values and the specific performance indicators (criteria) contained in the rubric. Note that the specific performance indicators only typify a student's response in a given score category. An exact match is not anticipated.

Irregularities in Standards Tests

During the administration of standards tests, supervising teachers may encounter irregularities. Markers may also encounter irregularities during local marking sessions. Appendix D provides examples of such irregularities as well as procedures to follow to report irregularities.

If an *Answer/Scoring Sheet* (Written Test) or a *Scoring Sheet* (Inquiry Task) is marked with "NR" and/or "0" only (e.g., student was present but did not attempt any questions) please document this on the *Irregular Test Paper Report*.

Assistance

If, during marking, any issue arises that cannot be resolved locally, please call Manitoba Education, Citizenship and Youth at the earliest opportunity to advise and/or seek assistance. If required, we will connect you to an advisor. Also, please be sure to notify us before making any modifications to the answer/marking keys or scoring rubrics.

Contact person: Barbara Riou, Consultant, at 945-4035 or toll-free at 1 800 282-8069, ext. 4035

Answer Key
for Selected-Response Items

Question No.	Answer	Outcome
1	B	A2
2	C	A1
3	B	B1
4	D	B2
5	A	C1
6	D	C2
7	B	D2
8	A	D3
9	D	E2

Marking Keys and Scoring Rubrics for Constructed-Response Items

Specific Outcome: A2 **Item Type: Restricted Response**

Question No. 10 and Answer

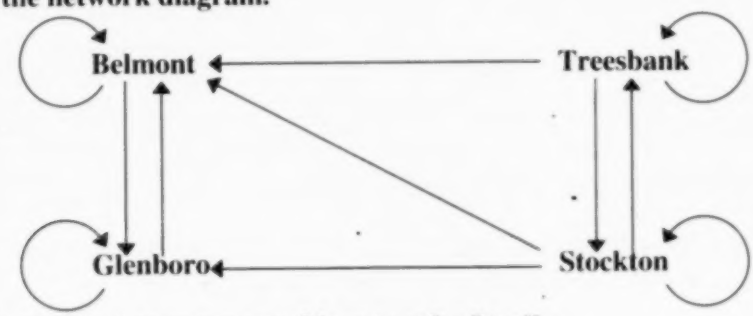
10. An organization of snowmobilers has formed the following network of trails:

Total: 3 marks

- **Each town has a local trail that begins and ends in its own town.**
- **One direct route from Belmont to Glenboro.**
- **One direct route from Treesbank to Stockton.**
- **One direct route from Treesbank to Belmont.**
- **One direct route from Glenboro to Belmont.**
- **One direct route from Stockton to each of the following towns: Treesbank, Belmont and Glenboro.**

a) Draw the network diagram.

(1 mark)



b) Create matrix *A* to represent this network of trails.

(1 mark)

$$A = \begin{array}{c} \\ \text{(From)} \end{array} \begin{array}{c} \begin{array}{cccc} \text{B} & \text{G} & \text{S} & \text{T} \end{array} \\ \begin{bmatrix} 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 \\ 1 & 1 & 1 & 1 \\ 1 & 0 & 1 & 1 \end{bmatrix} \end{array} \begin{array}{l} \text{B} \\ \text{G} \\ \text{S} \\ \text{T} \end{array}$$

(To)

c) Show the matrix operations to calculate the number of trails from one town to another passing through at most two other towns. Do not solve.

(1 mark)

$$A + A^2 + A^3$$

Marker Note(s):

- *Network diagrams must have loops indicating the local trail in a).*
- *Maximum 0.5 mark deduction for each kind of technical communication error (incorrect use of brackets on matrices, or not expressing transition matrices as decimals or percentages).*

Marking Key
1 mark for correct diagram in a)
1 mark for correct network matrix in b) consistent with work in a)
1 mark for correct matrix operations in c)

Specific Outcomes: A1, A2 **Item Type: Restricted Response with Explanation**

Question No. 11 and Answer

11. A chain of music stores had the following weekly sales in its three Manitoba stores:

Total: 4 marks

	Winnipeg	Brandon	Dauphin
T-shirt	173	57	16
CD	780	289	67
DVD	470	163	45
Poster	302	94	27

The following chart shows the cost to customers and the cost to stores for each item.

	T-shirt	CD	DVD	Poster
Cost to customers	$19.95	$18.95	$24.95	$4.99
Cost to stores	$5.10	$4.50	$7.25	$1.15

a) Use matrix operations to calculate the GST on the weekly sales from each store. Show your work and indicate your answer in matrix form.

(2 marks)

$$0.07 \times \begin{matrix} \begin{bmatrix} \text{T} & \text{C} & \text{D} & \text{P} \\ 19.95 & 18.95 & 24.95 & 4.99 \end{bmatrix} \times \end{matrix} \begin{matrix} \\ \text{T} \\ \text{C} \\ \text{D} \\ \text{P} \end{matrix} \begin{matrix} \begin{matrix} \text{W} & \text{B} & \text{D} \end{matrix} \\ \begin{bmatrix} 173 & 57 & 16 \\ 780 & 289 & 67 \\ 470 & 163 & 45 \\ 302 & 94 & 27 \end{bmatrix} \end{matrix} = \begin{matrix} \begin{matrix} \text{W} & \text{B} & \text{D} \end{matrix} \\ \begin{bmatrix} 2202.61 & 780.47 & 199.24 \end{bmatrix} \end{matrix}$$

Question No. 11 continued

b) Use matrix operations to calculate the weekly profit from each store. Show your work and indicate your answer in matrix form.

(2 marks)

$$B = \begin{bmatrix} 19.95 & 18.95 & 24.95 & 4.99 \end{bmatrix}$$

$$C = \begin{bmatrix} 5.10 & 4.50 & 7.25 & 1.15 \end{bmatrix}$$

$$A = \begin{bmatrix} 173 & 57 & 16 \\ 780 & 289 & 67 \\ 470 & 163 & 45 \\ 302 & 94 & 27 \end{bmatrix}$$

$$B - C = \begin{bmatrix} 14.85 & 14.45 & 17.70 & 3.80 \end{bmatrix}$$

$$\text{Profit} = \begin{bmatrix} 14.85 & 14.45 & 17.70 & 3.80 \end{bmatrix} \times A$$

$$= \begin{bmatrix} 23\,318.73 & 8268.56 & 2105.93 \end{bmatrix}$$

Winnipeg Brandon Dauphin

OR

$$(B - C) \times (A)$$

$$= \left(\begin{bmatrix} 19.95 & 18.95 & 24.95 & 4.99 \end{bmatrix} - \begin{bmatrix} 5.10 & 4.50 & 7.25 & 1.15 \end{bmatrix} \right) \times \begin{bmatrix} 173 & 57 & 16 \\ 780 & 289 & 67 \\ 470 & 163 & 45 \\ 302 & 94 & 27 \end{bmatrix}$$

$$= \begin{bmatrix} 23\,318.73 & 8268.56 & 2105.93 \end{bmatrix}$$

Winnipeg Brandon Dauphin

Marker Note(s):

- *Maximum 0.5 mark deduction for each kind of technical communication error (incorrect use of brackets on matrices, or not expressing transition matrices as decimals or percentages).*

Marking Key
1 mark for work shown indicating an appropriate strategy including matrix operations in a)
1 mark for correct answer in a)
1 mark for work shown indicating an appropriate strategy including matrix operations in b)
1 mark for correct answer in b)

Specific Outcome: B3 **Item Type: Open Response**

Question No. 12 and Answer

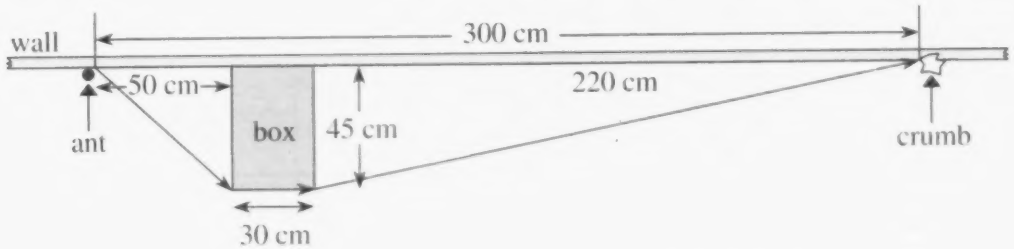
12. A hungry ant has a problem. A crumb from a sandwich has fallen to the ground 3 metres east of the ant. The ant wants to eat the crumb but a 30 cm × 45 cm box has been pushed tightly against the wall and is in its path.

Total: 5 marks

a) Using the given diagram, sketch a vector diagram and calculate the shortest route along the ground that the ant can take to reach the crumb. Diagram is not drawn to scale.

(2 marks)

Top View



$c^2 = a^2 + b^2$

$c^2 = 50^2 + 45^2$

$c^2 = 4525$

$c = 67.27$ cm

$c^2 = a^2 + b^2$

$c^2 = (300 - 80)^2 + 45^2$

$c^2 = 50\,425$

$c = 224.55$ cm

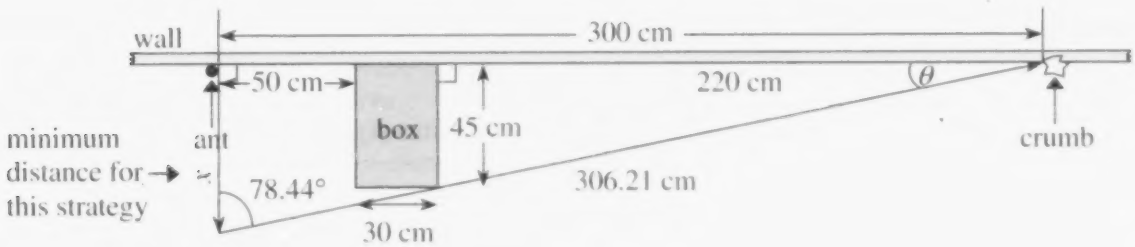
minimum distance = 67.27 cm + 30 cm + 224.55 cm = 321.82 cm ***OR*** 3.22 m

Question No. 12 continued

b) Using only two vectors, sketch another route along the ground that the ant can take to reach the crumb. The ant can travel at 0.50 cm/s. Determine the distance the ant must travel and the length of time needed to get to the crumb. Indicate your strategy.

(3 marks)

Top View



$$\tan\theta = \frac{45}{220}$$

$$\theta = 11.56°$$

$$\tan 11.56° = \frac{x}{300}$$

$$x = 61.36 \text{ cm}$$

$$c^2 = a^2 + b^2$$

$$c^2 = 61.36^2 + 300^2$$

$$c^2 = 93\,765.05$$

$$c = 306.21 \text{ cm}$$

Using only two vectors, the ant could travel 61.36 cm south, then travel 306.21 cm at a bearing of 78.44° for a total distance of 367.57 cm.

Time: 61.36 cm + 306.21 cm $= \frac{367.57 \text{ cm}}{0.50 \text{ cm/s}} = 735.14$ seconds = 12 minutes 15 seconds

OR

Question No. 12 and Answer

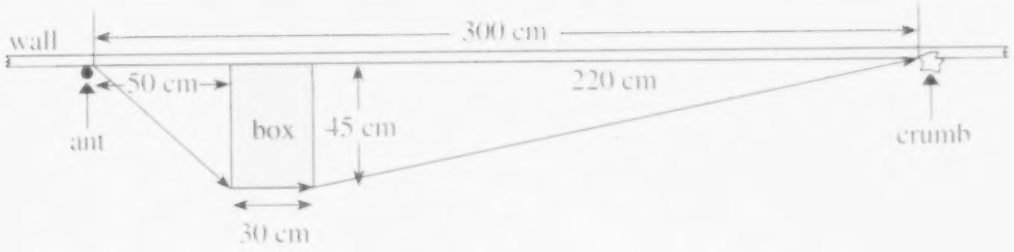
12. A hungry ant has a problem. A crumb from a sandwich has fallen to the ground 3 metres east of the ant. The ant wants to eat the crumb but a 30 cm × 45 cm box has been pushed tightly against the wall and is in its path.

Total: 5 marks

a) Using the given diagram, sketch a vector diagram and calculate the shortest route along the ground that the ant can take to reach the crumb. Diagram is not drawn to scale.

(2 marks)

Top View



$c^2 = a^2 + b^2$

$c^2 = 50^2 + 45^2$

$c^2 = 4525$

$c = 67.27$ cm

$c^2 = a^2 + b^2$

$c^2 = (300 - 80)^2 + 45^2$

$c^2 = 50\,425$

$c = 224.55$ cm

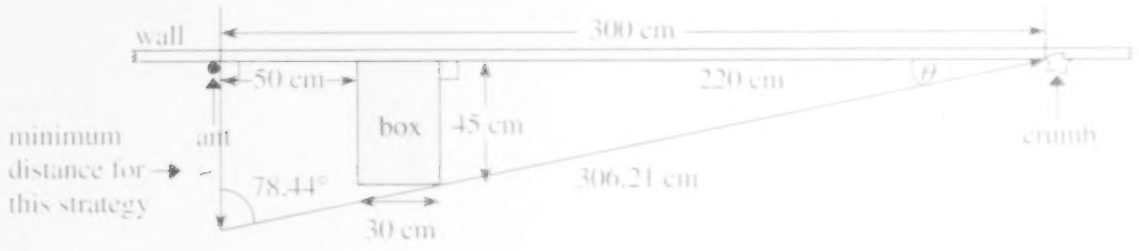
minimum distance = 67.27 cm + 30 cm + 224.55 cm = 321.82 cm ***OR*** 3.22 m

Question No. 12 continued

b) Using only two vectors, sketch another route along the ground that the ant can take to reach the crumb. The ant can travel at 0.50 cm/s. Determine the distance the ant must travel and the length of time needed to get to the crumb. Indicate your strategy.

(3 marks)

Top View



$$\tan\theta = \frac{45}{220}$$

$$\theta = 11.56$$

$$\tan 11.56^\circ = \frac{x}{300}$$

$$x = 61.36 \text{ cm}$$

$$c^2 = a^2 + b^2$$

$$c^2 = 61.36^2 + 300^2$$

$$c^2 = 93\,765.05$$

$$c = 306.21 \text{ cm}$$

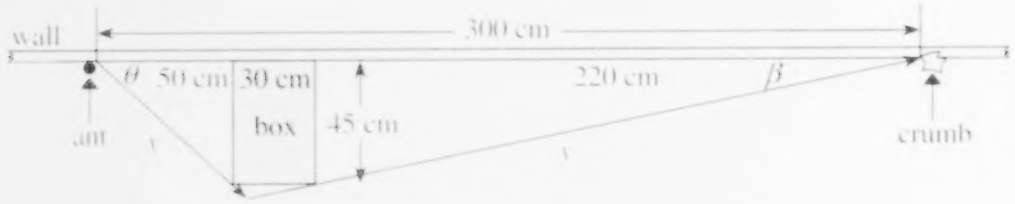
Using only two vectors, the ant could travel 61.36 cm south, then travel 306.21 cm at a bearing of 78.44° for a total distance of 367.57 cm.

Time: 61.36 cm + 306.21 cm $= \frac{367.57 \text{ cm}}{0.50 \text{ cm/s}} = 735.14$ seconds $= 12$ minutes 15 seconds

OR

Question No. 12 continued

Top View



$$\tan\theta = \frac{45}{50} \qquad \tan\beta = \frac{45}{220}$$

$$\theta = 42^\circ \qquad \beta = 11.56^\circ$$

Trisolve:

$A = 42^\circ$

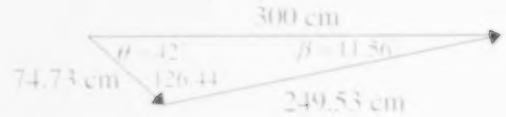
$c = 300$ cm

$B = 11.56^\circ$

$b = 74.73$ cm

$a = 249.53$ cm

$C = 126.44^\circ$



Using a minimum of two vectors = 249.53 cm + 74.73 cm = 324.26 cm

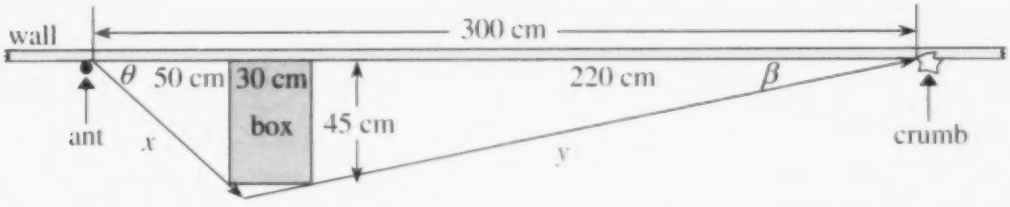
Time: $\dfrac{324.26 \text{ cm}}{0.50 \text{ cm/s}} = 648.52$ seconds = 10 minutes 48.52 seconds = 10.81 minutes

Please note that these are minimum values for this question. The student must have a distance of 324.26 cm (3.24 m) and a time of 648.52 seconds (10 minutes 48.52 seconds) or greater.

Other answers are possible.

Question No. 12 continued

Top View



$$\tan\theta = \frac{45}{50} \qquad \tan\beta = \frac{45}{220}$$

$$\theta = 42^\circ \qquad \beta = 11.56^\circ$$

Trisolve:

$A = 42^\circ$

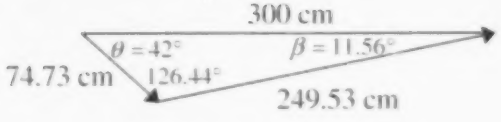
$c = 300$ cm

$B = 11.56^\circ$

$b = 74.73$ cm

$a = 249.53$ cm

$C = 126.44^\circ$



Using a minimum of two vectors = 249.53 cm + 74.73 cm = 324.26 cm

$$\text{Time: } \frac{324.26 \text{ cm}}{0.50 \text{ cm/s}} = 648.52 \text{ seconds} = 10 \text{ minutes } 48.52 \text{ seconds} = 10.81 \text{ minutes}$$

Please note that these are minimum values for this question. The student must have a distance of 324.26 cm (3.24 m) and a time of 648.52 seconds (10 minutes 48.52 seconds) or greater.

Other answers are possible.

Question No. 12 continued

Scoring Rubric

General Performance Indicators	
Level 1—limited understanding	
1 mark **weak attempt: inappropriate strategy or no strategy** 1 criterion correct	**2 marks** **reasonable attempt: appropriate strategy with major errors or omissions** 2 criteria correct
Level 2—good understanding	
3 marks **reasonable strategy, minor errors and/or omissions** 3 criteria correct	**4 marks** **sound strategy, mostly complete, minor errors** 4 criteria correct
Level 3—exceptional understanding	
5 marks **complete and correct** 5 criteria correct	

Marker Note(s):

- *Maximum 0.5 mark deduction for each kind of technical communication error (missing more than one arrow in a vector diagram or not stating a scale when using a scale diagram as a strategy) in a) only.*

Marking Key
1 mark for sketch of route in a) *1 mark for correct distance of 321.82 cm in a)* *1 mark for work shown indicating an appropriate strategy using only 2 vectors in b)* *1 mark for distance in b) consistent with diagram in b)* *1 mark for time consistent with diagram in b)*

Exemplar 1

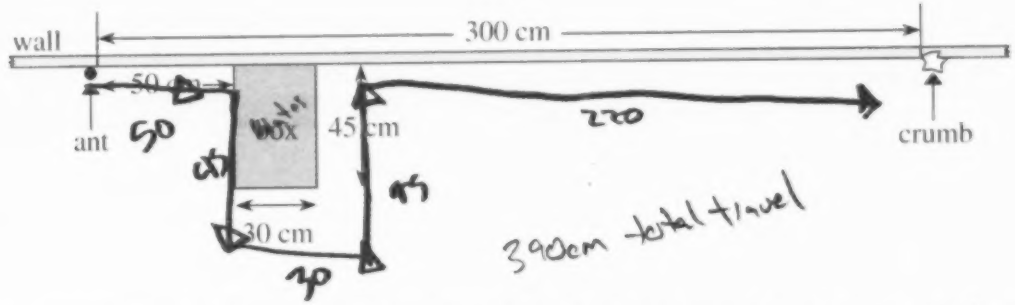
12. A hungry ant has a problem. A crumb from a sandwich has fallen to the ground 3 metres east of the ant. The ant wants to eat the crumb but a 30 cm × 45 cm box has been pushed tightly against the wall and is in its path.

Total: 5 marks

a) Using the given diagram, sketch a vector diagram and calculate the shortest route along the ground that the ant can take to reach the crumb. Diagram is not drawn to scale.

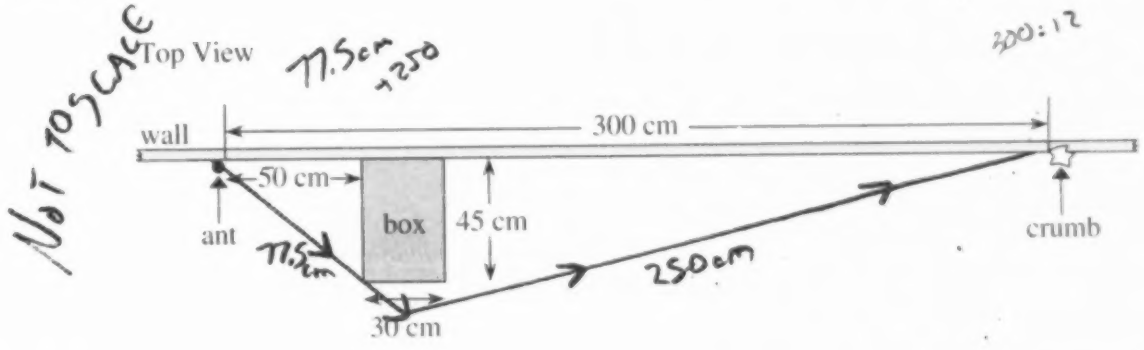
(2 marks)

Top View



b) Using only two vectors, sketch another route along the ground that the ant can take to reach the crumb. The ant can travel at 0.50 cm/s. Determine the distance the ant must travel and the length of time needed to get to the crumb. Indicate your strategy.

(3 marks)



10.916 minutes to travel 327.5cm for the ant

4 marks:

- 1 mark for sketch of route in a)
- 1 mark for work shown indicating an appropriate strategy using only 2 vectors in b)
- 1 mark for distance in b) consistent with diagram in b)
- 1 mark for time consistent with diagram in b)

Exemplar 2

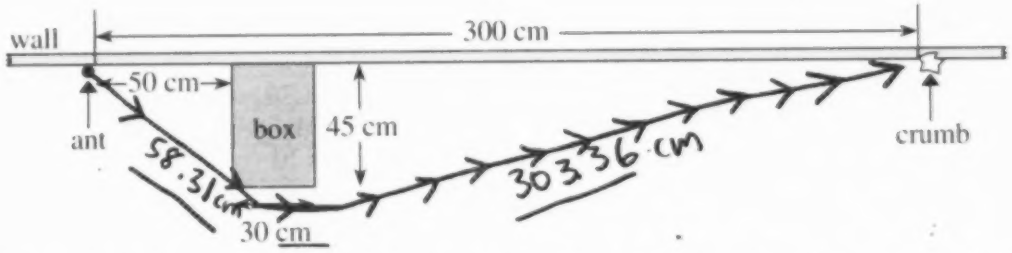
12. A hungry ant has a problem. A crumb from a sandwich has fallen to the ground 3 metres east of the ant. The ant wants to eat the crumb but a 30 cm × 45 cm box has been pushed tightly against the wall and is in its path.

Total: 5 marks

a) Using the given diagram, sketch a vector diagram and calculate the shortest route along the ground that the ant can take to reach the crumb. Diagram is not drawn to scale.

(2 marks)

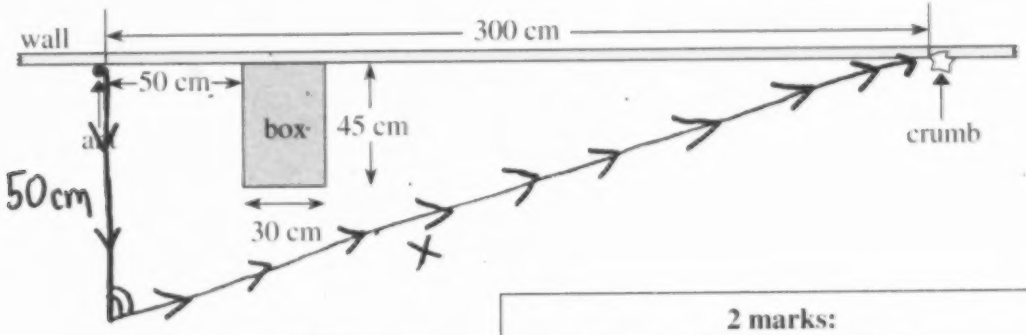
Top View



b) Using only two vectors, sketch another route along the ground that the ant can take to reach the crumb. The ant can travel at 0.50 cm/s. Determine the distance the ant must travel and the length of time needed to get to the crumb. Indicate your strategy.

(3 marks)

Top View



$300^2 + 50^2 = \sqrt{92500}$

$= 304.14$ cm

2 marks:

- 1 mark for sketch of route in a)
- 1 mark for work shown indicating an appropriate strategy using only 2 vectors in b)

$\tan x = \frac{300}{50}$

$= \tan^{-1}\left(\frac{300}{50}\right)$

$= 80.54°$

The ant will take 15.21 minutes to travel 304.14 cm

The route is as shown above

Exemplar 1

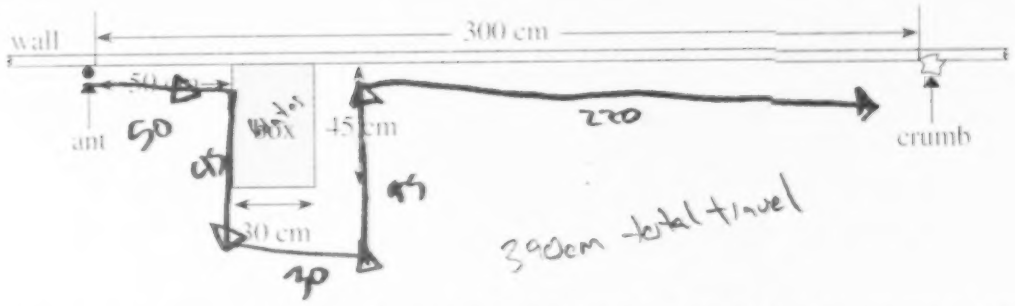
12. A hungry ant has a problem. A crumb from a sandwich has fallen to the ground 3 metres east of the ant. The ant wants to eat the crumb but a 30 cm × 45 cm box has been pushed tightly against the wall and is in its path.

Total: 5 marks

a) Using the given diagram, sketch a vector diagram and calculate the shortest route along the ground that the ant can take to reach the crumb. Diagram is not drawn to scale.

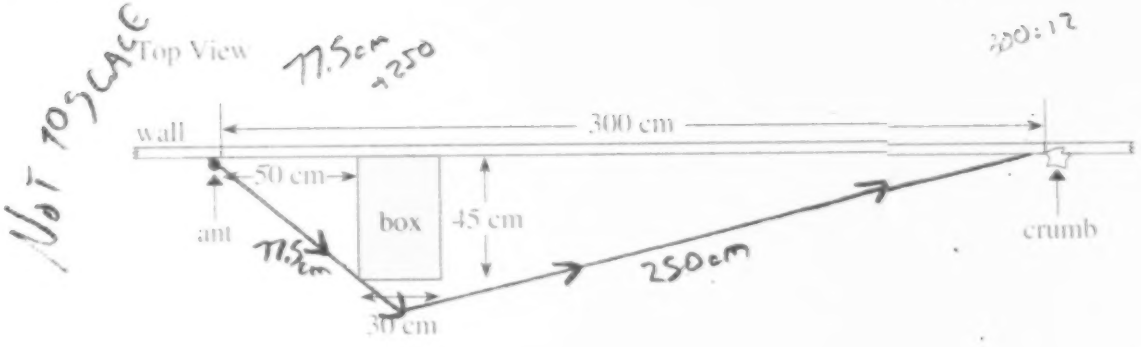
(2 marks)

Top View



b) Using only two vectors, sketch another route along the ground that the ant can take to reach the crumb. The ant can travel at 0.50 cm/s. Determine the distance the ant must travel and the length of time needed to get to the crumb. Indicate your strategy.

(3 marks)



10.916̄ minutes to travel 327.5cm for the ant

4 marks:

- 1 mark for sketch of route in a)
- 1 mark for work shown indicating an appropriate strategy using only 2 vectors in b)
- 1 mark for distance in b) consistent with diagram in b)
- 1 mark for time consistent with diagram in b)

Exemplar 2

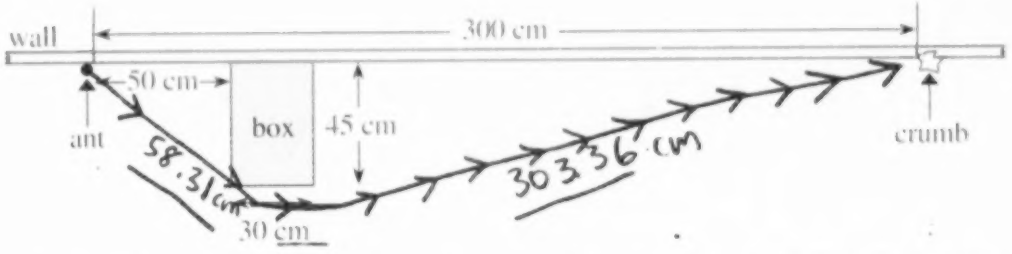
12. A hungry ant has a problem. A crumb from a sandwich has fallen to the ground 3 metres east of the ant. The ant wants to eat the crumb but a 30 cm × 45 cm box has been pushed tightly against the wall and is in its path.

Total: 5 marks

a) Using the given diagram, sketch a vector diagram and calculate the shortest route along the ground that the ant can take to reach the crumb. Diagram is not drawn to scale.

(2 marks)

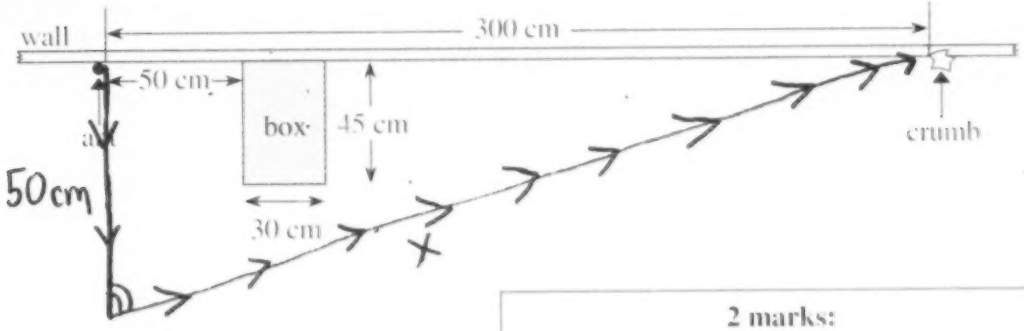
Top View



b) Using only two vectors, sketch another route along the ground that the ant can take to reach the crumb. The ant can travel at 0.50 cm/s. Determine the distance the ant must travel and the length of time needed to get to the crumb. Indicate your strategy.

(3 marks)

Top View



$300^2 + 50^2 = \sqrt{92500}$

$= 304.14$ cm

2 marks:

- 1 mark for sketch of route in a)
- 1 mark for work shown indicating an appropriate strategy using only 2 vectors in b)

$\tan x = \frac{300}{50}$

$= \tan^{-1}\left(\frac{300}{50}\right)$

$= 80.54°$

The ant will take 15.21 minutes to travel 304.14 cm

The route is as shown above

Specific Outcome: B3 **Item Type: Restricted Response with Explanation**

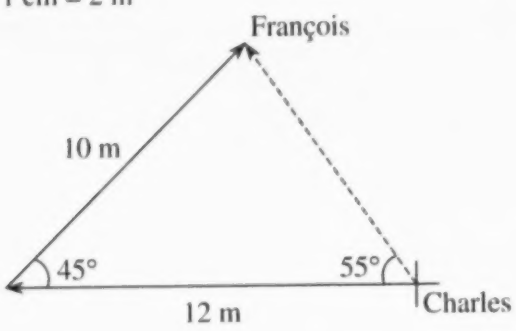
Question No. 13 and Answer

13. Charles and his brother François are playing a game of "water bombers" with water balloons in a corn maze. Charles remains at the entrance of the maze while François walks 12 metres west and then 10 metres northeast.

In what direction should Charles throw his water balloon in order to hit his brother? Indicate your strategy.

Total: 2 marks

1 cm = 2 m



Charles should throw the water balloon 55° north of west.

OR

Solvetri:

Input:	Output:
a = 10	A = 55.10°
b = 12	B = 79.90°
C = 45°	c = 8.62

Charles should throw the water balloon 55.10° north of west.

Marker Note(s):

- *Maximum 0.5 mark deduction for each kind of technical communication error (missing more than one arrow in a vector diagram or not stating a scale when using a scale diagram as a strategy).*

Marking Key
1 mark for work shown indicating an appropriate strategy
1 mark for correct answer

Specific Outcome: C2 **Item Type: Restricted Response**

Question No. 14 and Answer

14. The Coopers buy a condominium for $100 000.00 with a down payment of $20 000.00. The mortgage is amortized over 25 years at an interest rate of 6.50% compounded monthly.

Total: 4 marks

a) What will their monthly mortgage payment be?

(2 marks)

If compounded monthly:

N =	300
I% =	6.50
PV =	80 000
PMT =	**–540.17**
FV =	0
P/Y =	12
C/Y =	12
PMT =	END

OR

N =	300
I% =	6.50
PV =	80 000
PMT =	**–537.26**
FV =	0
P/Y =	12
C/Y =	12
PMT =	BEGIN

b) Determine the amount left owing on the mortgage and the amount of interest the Coopers will have paid at the end of 10 years.

(2 marks)

*FV is based on a payment that has been rounded to the nearest two decimal places.

N =	120
I% =	6.50
PV =	80 000
PMT =	–540.17
FV =	**–62 008.37**
P/Y =	12
C/Y =	12
PMT =	END

Total principal: $100 000.00 – $20 000.00 – $62 008.37 = $17 991.63
Total payments: 120 × $540.17 = $64 820.40
Total interest paid: $64 820.40 – $17 991.63 = $46 828.77

OR

Question No. 14 continued

N =	120
I% =	6.50
PV =	80 000
PMT =	–540.17
FV =	**–62 008.34**
P/Y =	12
C/Y =	12
PMT =	BEGIN

Total principal: $100 000.00 – $20 000.00 – $62 008.34 = $17 991.66
Total payments: 120 × $540.17 = $64 820.40
Total interest paid: $64 820.40 – $17 991.66 = $46 828.74

OR

N =	120
I% =	6.50
PV =	80 000
PMT =	–540.17
FV =	**–62 008.37**
P/Y =	12
C/Y =	12
PMT =	END

$\sum$ Int (1, 120) = $46 828.77

OR

Interest paid: $46 828.77 (if compounded monthly)

Number	Interest	Principal	Remaining
0			80 000.00
1	433.3333	106.8366	79 893.16
2	432.7546	107.4153	79 785.74
3	432.1728	107.9971	79 677.75
4	431.5878	108.5821	79 569.16
5	430.9996	109.1703	79 459.99
⋮	⋮	⋮	⋮
119	338.0739	202.0960	62 211.55
120	336.9792	203.1907	**62 008.36**
	46 828.77		

Question No. 14 continued

Number	Interest	Principal	Remaining
0			80 000.00
=A2+1	=D2*0.065/12	=540.17-B3	=D2-C3
=A3+1	=D3*0.065/12	=540.17-B4	=D3-C4
=A4+1	=D4*0.065/12	=540.17-B5	=D4-C5
=A5+1	=D5*0.065/12	=540.17-B6	=D5-C6
=A6+1	=D6*0.065/12	=540.17-B7	=D6-C7
⋮	⋮	⋮	⋮
=A120+1	=D120*0.065/12	=540.17-B121	=D120-C121
=A121+1	=D121*0.065/12	=540.17-B122	=D121-C122
	46 828.77		

Marking Key
1 mark for subtracting the down payment in a)
1 mark for correct payment of $540.17 in a)
1 mark for amount left owing on loan in b)
1 mark for interest paid in b) consistent with work in a)

Specific Outcome: C3 **Item Type: Restricted Response**

Question No. 15 and Answer

15. Carl wants to buy or lease a car. The purchase price is $31 920.00 including taxes. Carl has a down payment of $2000.00 to purchase or lease the car. The finance rate is 4.50% compounded monthly.

Total: 4 marks

a) Calculate Carl's monthly payment if he purchases the car and finances it over a period of 5 years.

(2 marks)

N =	60	N =	60
I% =	4.50	I% =	4.50
PV =	29 920	PV =	29 920
PMT =	**–557.80**	PMT =	**–555.72**
FV =	0	FV =	0
P/Y =	12	P/Y =	12
C/Y =	12	C/Y =	12
PMT =	END	PMT =	BEGIN

OR

b) Carl can lease the car for $375.00 a month (including taxes) for a period of 48 months. After this time, the residual value of the car is 40% of the original purchase price of $31 920.00. Calculate the total price including the down payment of $2000.00 and the lease payments to purchase the car at the end of the lease. Indicate your strategy.

(2 marks)

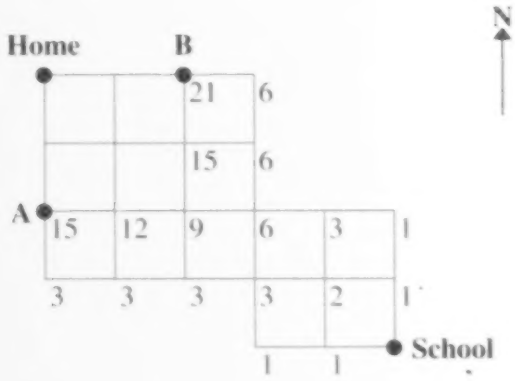
down payment:		= $2000.00	
lease:	$375.00 × 48	= $18 000.00	
residual value:	$31 920.00 × 0.40	= $12 768.00	
total price:		= $32 768.00	(assuming that $12 768.00 is available in cash at the end of 4 years)

Marking Key
1 mark for subtracting the down payment in a)
1 mark for correct monthly payment in a)
1 mark for residual value in b)
1 mark for total price to purchase the car in b)

Question No. 16 and Answer

16. James must go to the grocery store on his way home from school. He must travel north or west along the streets indicated in the diagram below. He thinks that there are more ways to get home if he stops at grocery store A. His mother thinks that there are more ways to get home by stopping at grocery store B. Explain who is correct. Support your answer.

Total: 2 marks



School → Grocery store A = 15 ways

School → Grocery store B = 21 ways

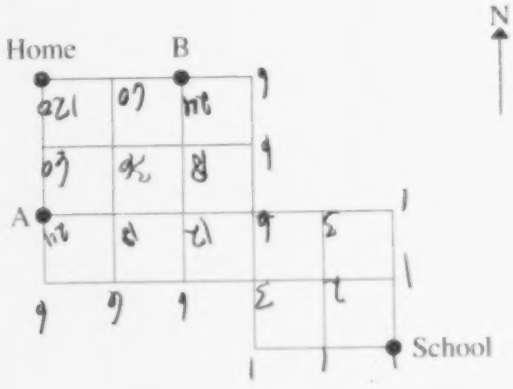
Conclusion: His mom is correct.

Marking Key
1 mark for work shown indicating a correct strategy
1 mark for answer consistent with strategy

Exemplar 1

16. James must go to the grocery store on his way home from school. He must travel north or west along the streets indicated in the diagram below. He thinks that there are more ways to get home if he stops at grocery store A. His mother thinks that there are more ways to get home by stopping at grocery store B. Explain who is correct. Support your answer.

Total: 2 marks



They are both wrong. They are the exact same distance so the same amount of routes to get to each store

1 mark:

- 1 mark for answer consistent with error in strategy

Specific Outcome: D2 **Item Type: Restricted Response with Explanation**

Question No. 17 and Answer

17. Manitoba licence plates are made up of 3 letters followed by a 3-digit number.

How many licence plates can be made if the third letter must be an E and the 3-digit number must be greater than or equal to 300? Indicate your strategy.

Total: 2 marks

$$26 \times 26 \times 1 \times 7 \times 10 \times 10 = 473\ 200$$

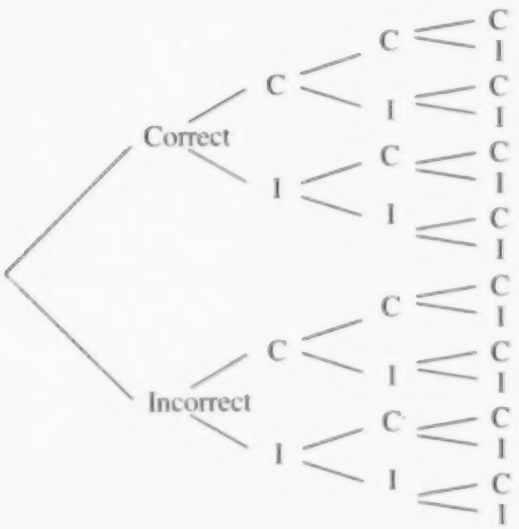
Marking Key
1 mark for work shown indicating an appropriate strategy
1 mark for correct answer

Specific Outcomes: D4, D5 **Item Type: Restricted Response with Explanation**

Question No. 18 and Answer

18. A quiz is made up of 4 true or false questions. Determine the probability that you will have at least one correct answer if you guessed the answers to all 4 questions. Indicate your strategy.

Total: 2 marks



There is a $\frac{15}{16}$ chance of having at least 1 correct answer.

OR

$$1 - \frac{1}{16} = \frac{15}{16}$$

OR

1 – binomcdf (4, 0.50, 0) = 0.94

OR

1 – binompdf (4, 0.50, 0) = 0.94

Marking Key
1 mark for work shown indicating an appropriate strategy *1 mark for correct answer*

Specific Outcomes: E1, E2 **Item Type: Restricted Response**

Question No. 19 and Answer

19. The following data represents the points the Winnipeg Blue Bombers scored in each game during their 2003 football season:

Total: 2 marks

15	39	54	27	21	37	18	22
19	26	48	31	22	35	51	42

a) Find the population standard deviation for the football scores. Round your answer to two decimal places.

(1 mark)

$$\sigma = 12.04$$

b) The mean score for the 2003 season was 31.69. What is the z-score for the football game in which the team scored 39 points?

(1 mark)

$$z\text{-score} = \frac{39 - 31.69}{12.04}$$
$$= 0.61$$

Marking Key
1 mark for correct answer in a)
1 mark for correct answer in b) consistent with work in a)

Specific Outcome: E2 **Item Type: Restricted Response with Explanation**

Question No. 20 and Answer

20. The height of adult females in Canada is normally distributed with a mean of 164 cm and a standard deviation of 4.10 cm.

Total: 4 marks

a) Prior to 1985, the Winnipeg Police Service considered a height of 157 cm or less to be too short for women to join the police service. What percentage of adult females would have been too short to join the police force at that time? Indicate your strategy.

(2 marks)

normalcdf (–E99, 157, 164, 4.10) = 0.044 or 4.40%

OR

$$z = \frac{1.57 - 1.64}{4.10} = -1.71$$

normalcdf (–5, –1.71) = 0.044 or 4.40%

OR

$$z = \frac{1.57 - 1.64}{4.10} = -1.71$$

0.50 – 0.4564 = 0.044 or 4.40%

OR

Normal Distribution Probabilities	
Score 1	157
Score 2	
Mean	164
Standard Deviation	4.10
P (< Score 1)	0.044
P (> Score 1)	0.956
P (< Score 2)	0
P (> Score 2)	1
P (> Score 1, < Score 2)	–0.044

= 0.044 or 4.40%

Question No. 20 continued

b) At that time, approximately 11.10% of adult females were too short to enlist in the Brandon Police Service. What minimum height was being used in the Brandon Police Service selection process? Indicate your strategy.

(2 marks)

$$\text{invNorm}(0.111, 164, 4.10)$$

The Brandon Police Service used 159 cm.

OR

$$\text{invNorm}(0.111) = -1.22$$

$$-1.22 = \frac{x - 164}{4.10}$$

$$x = 159 \text{ cm}$$

Marking Key
1 mark for work shown indicating an appropriate strategy in a)
1 mark for correct answer in a)
1 mark for work shown indicating an appropriate strategy in b)
1 mark for correct answer in b)

Specific Outcome: E3 **Item Type: Restricted Response with Explanation**

Question No. 21 and Answer

21. RCMP statistics show that there is a 15% probability that a motorist is speeding on the highway at Headingley.

Total: 3 marks

a) Determine a 95% confidence interval for the mean number of motorists who speed each day if 10 000 cars travel this highway daily. Indicate your strategy.

(2 marks)

1–PropZInt

$x = 1500$

$n = 10\,000$

C-level = 0.95

Calculate

$(0.143, 0.157) \times 10\,000 = (1430 - 1570)$

OR

$\overline{x} = np$

$= 10\,000 \times 0.15 = 1500$

$\sigma = \sqrt{npq}$

$= \sqrt{10\,000 \times 0.15 \times 0.85}$

$= 35.71$

$\text{minimum} = 1500 - 1.96 \times 35.71 = 1430$

$\text{maximum} = 1500 + 1.96 \times 35.71 = 1570$

b) Explain what the confidence interval means in this situation.

(1 mark)

There is a 95% chance that between 1430 and 1570 out of every 10 000 motorists are speeding.

OR

95% of the time the number of speeders will be between 1430 and 1570 out of every 10 000 motorists.

Marker Note(s):

- *Students must convert from the proportion of motorists to a whole number of motorists to receive the second mark in a); deduct 0.5 mark if the answer is not in a whole number of motorists in a).*

Marking Key
1 mark for work shown indicating an appropriate strategy in a) *1 mark for correct answer in a)* *1 mark for correct explanation in b)*

Exemplar 1

21. RCMP statistics show that there is a 15% probability that a motorist is speeding on the highway at Headingley.

Total: 3 marks

a) Determine a 95% confidence interval for the mean number of motorists who speed each day if 10 000 cars travel this highway daily. Indicate your strategy.

(2 marks)

10,000

$\mu \pm 2\sigma = 95\%$.

(A) 1 prop z int

$x = 1500$

$n: 10{,}000$.

Clevel = 95

(.143, .157)

$p = .15$

$n = 10{,}000$

$10{,}000 \pm (.43) = 4{,}300$

$10{,}000 \pm (.157) = 1570$

between 1570 – 4,300 motorists speed.

b) Explain what the confidence interval means in this situation.

(1 mark)

Confidence interval 95% states that if this information is somewhat realistic it will be around the 95% range.

2 marks:

- 1 mark for work shown indicating an appropriate strategy in a)
- 1 mark for correct answer based on trivial error in a)

Exemplar 2

21. RCMP statistics show that there is a 15% probability that a motorist is speeding on the highway at Headingley.

Total: 3 marks

a) Determine a 95% confidence interval for the mean number of motorists who speed each day if 10 000 cars travel this highway daily. Indicate your strategy.

(2 marks)

$\bar{x} = n \times p$

$= 10000 \times 0.15$

$\bar{x} = 1500$

$\delta = \sqrt{n \times p \times (1-p)}$

$= \sqrt{1500 \times (1-0.15)}$

$= \sqrt{1275}$

$\delta = 35.71$

$1500 + 1.96(35.71)$

$= 1569.99$

$1500 - 1.96(35.71)$

$= 1430.01$

1430.01 ⟷ 1569.99 speeders

b) Explain what the confidence interval means in this situation.

(1 mark)

This confidence interval gives a range of the almost minimum to almost maximum motorists who speed daily, and gives 95% of the data in this range.

1.5 marks:

- 1 mark for work shown indicating an appropriate strategy in a)
- 1 mark for correct answer in a)
- –0.5 mark for not stating number of motorists in a whole number

Question No. 22 and Answer

22. For several hundred years, astronomers have kept track of the sinusoidal behaviour of solar flares, or sunspots, which occur on the surface of the sun. The number of sunspots counted in a given year varies from a minimum of 10 to a maximum of 110. Between the maximums that occurred in the years 1732 and 1948, there were 18 complete cycles.

Total: 3 marks

a) What is the period for one sunspot cycle?

(1 mark)

$$(1948 - 1732) \div 18 = 12$$

The period is 12 years.

b) Write a sinusoidal equation that represents this cycle of sunspots.

(2 marks)

$$y = 50\sin(0.52x + 1.57) + 60$$

where x represents the number of years since the last maximum number of sunspots

OR

$$y = 50\cos\left[\frac{\pi}{6}(x - 216)\right] + 60$$

where x represents the number of years since 1732

OR

$$y = 50\cos\left(\frac{\pi}{6}x\right) + 60$$

where x represents the number of years since 1948

Other answers are possible.

Marker Note(s):

- *If "y =" is missing from an equation, deduct 0.5 mark.*

Marking Key
1 mark for correct period in a) *2 marks for correct equation in b) (0.5 mark for each parameter: a, b, c, d)*

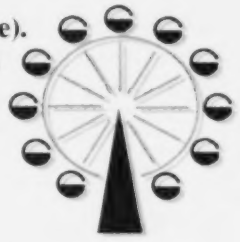
Specific Outcomes: G1, G2 **Item Type: Open Response**

Question No. 23 and Answer

23. You have been asked to design a Ferris wheel with the following parameters:

Total: 4 marks

- **The diameter must be between 20 m and 40 m (inclusive).**
- **The number of rotations per minute must be between 4 and 8 (inclusive).**
- **There must be at least 1 m between the bottom of the Ferris wheel and the ground.**



State your Ferris wheel dimensions:

diameter = _____

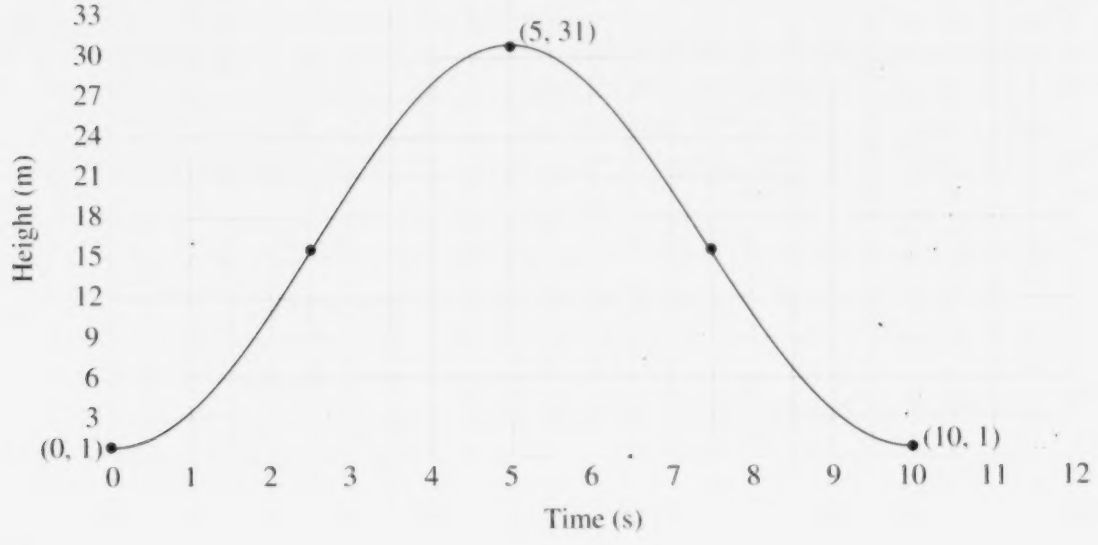
rotations per minute = _____

ground clearance = _____

a) Draw a graph showing one full rotation for a passenger on your Ferris wheel. Your graph must show the period as well as the maximum and minimum heights.

(2 marks)

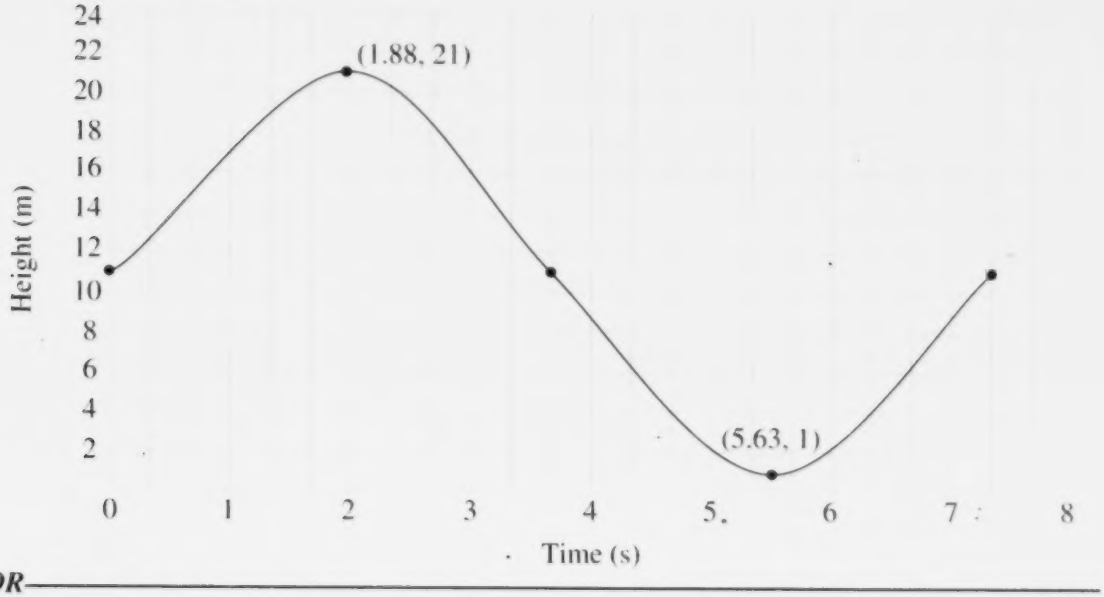
diameter = 30 m
rotations per minute = 6
ground clearance = 1 m



OR

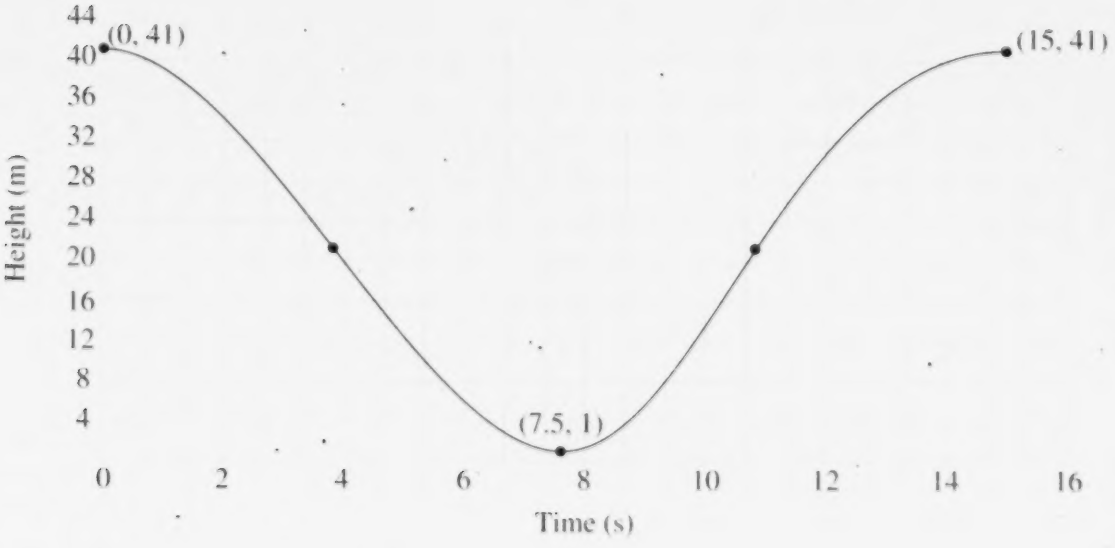
Question No. 23 continued

diameter = 20 m
rotations per minute = 8
ground clearance = 1 m



OR

diameter = 40 m
rotations per minute = 4
ground clearance = 1 m



Other answers are possible.

Question No. 23 continued

b) Using your graph, determine the sinusoidal equation that represents the motion of a passenger once they have reached a constant speed.

(2 marks)

$$y = 15\sin\left[\frac{\pi}{5}(x - 2.50)\right] + 16$$
$$= 15\sin(0.63x - 1.57) + 16$$

OR

$$y = 10\sin 0.84x + 11$$

OR

$$y = 20\cos 0.42x + 21$$

Other answers are possible.

Question No. 23 continued

Scoring Rubric

<table>
<tr><th colspan="2">General Performance Indicators</th></tr>
<tr><td colspan="2">Level 1—limited understanding</td></tr>
<tr><td colspan="2">1 mark
weak attempt: inappropriate strategy or no strategy
1 criterion correct</td></tr>
<tr><td colspan="2">Level 2—good understanding</td></tr>
<tr><td>2 marks
reasonable attempt: appropriate strategy, minor errors and/or omissions
2 criteria correct</td><td>3 marks
complete and correct with minor errors
3 criteria correct</td></tr>
<tr><td colspan="2">Level 3—exceptional understanding</td></tr>
<tr><td colspan="2">4 marks
complete and correct
4 criteria correct</td></tr>
</table>

Marker Note(s):

- *Deduct 1 mark if student chooses values outside of the given parameters.*
- *If "y =" is missing from an equation, deduct 0.5 mark.*

Marking Key
1 mark for minimum and maximum heights above the ground in a)
1 mark for correct period in a)
2 marks for correct equation (0.5 mark for each parameter: a, b, c, d) in b)

Exemplar 1

23. You have been asked to design a Ferris wheel with the following parameters:

Total: 4 marks

- The diameter must be between 20 m and 40 m (inclusive).
- The number of rotations per minute must be between 4 and 8 (inclusive).
- There must be at least 1 m between the bottom of the Ferris wheel and the ground.

State your Ferris wheel dimensions:

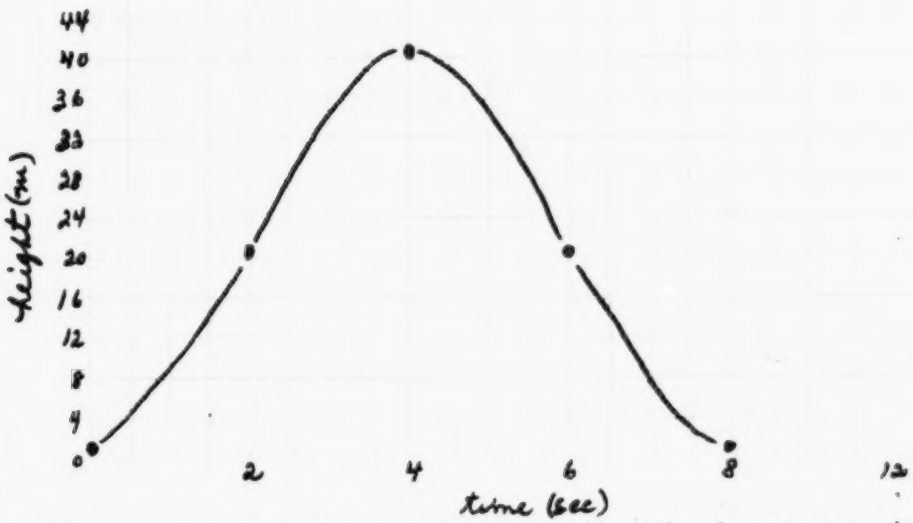
diameter = 40

rotations per minute = 8

ground clearance = 1

a) Draw a graph showing one full rotation for a passenger on your Ferris wheel. Your graph must show the period as well as the maximum and minimum heights.

(2 marks)



b) Using your graph, determine the sinusoidal equation that represents the motion of a passenger once they have reached a constant speed.

(2 marks)

a = 20 c = -1.57

b = .79 d = 21

2.5 marks:

- 1 mark for minimum and maximum heights in a)
- 2 marks for correct equation in b)
- –0.5 mark for parameters not being in equation form

Exemplar 2

23. You have been asked to design a Ferris wheel with the following parameters:

Total: 4 marks

- The diameter must be between 20 m and 40 m (inclusive).
- The number of rotations per minute must be between 4 and 8 (inclusive).
- There must be at least 1 m between the bottom of the Ferris wheel and the ground.

State your Ferris wheel dimensions:

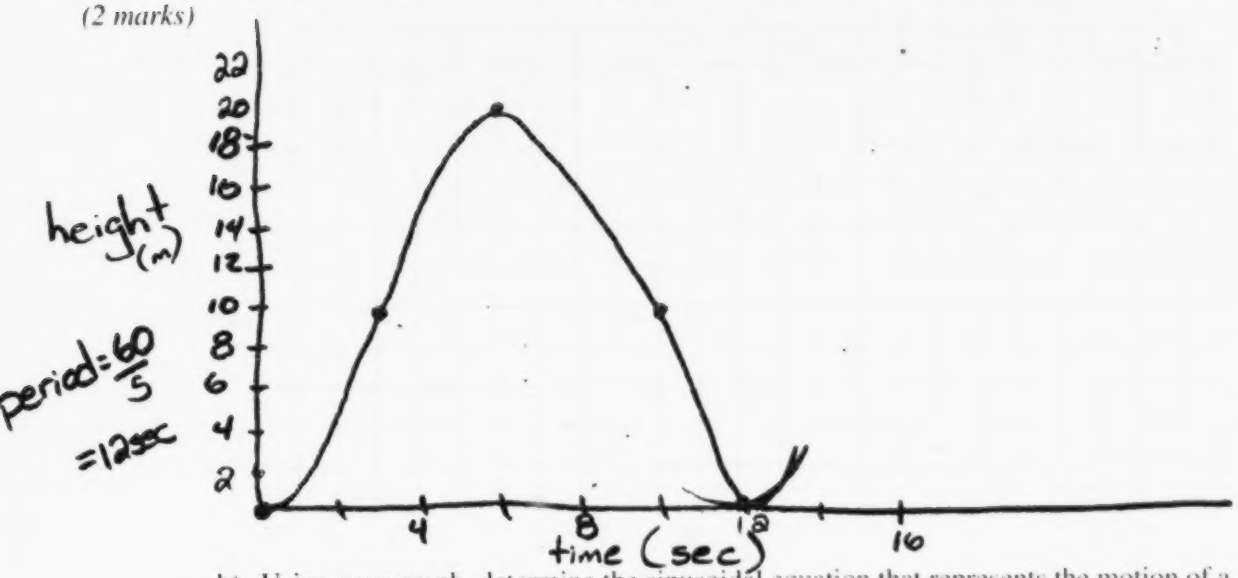
diameter = 20

rotations per minute = 5

ground clearance = 2

a) Draw a graph showing one full rotation for a passenger on your Ferris wheel. Your graph must show the period as well as the maximum and minimum heights.

(2 marks)



b) Using your graph, determine the sinusoidal equation that represents the motion of a passenger once they have reached a constant speed.

(2 marks)

$y = 7.5\sin(.52x - 1.57) + 7.5$

2 marks:

- 1 mark for correct period in a)
- 1 mark for correct parameters b and c in equation in b)

Marking Keys and Scoring Rubrics for the Inquiry Task

Specific Outcomes: F1, F2, F3 **Item Type: Open Response**

Inquiry Task Question No. 1 and Answer

DESIGN AND MEASUREMENT

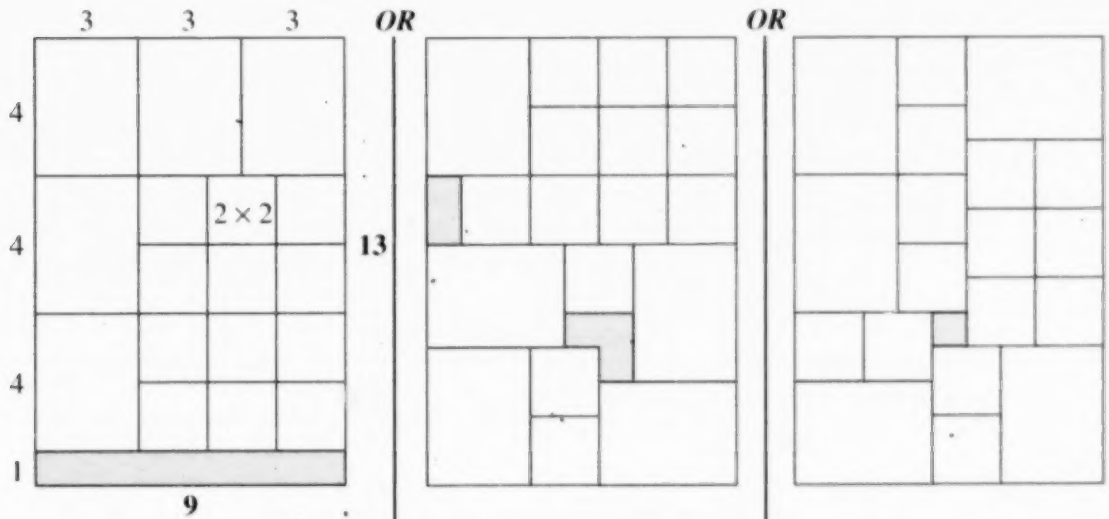
1. Linda has prepared two cakes. One is in a rectangular pan that measures 9 inches by 13 inches, with a depth of 3 inches. The other is in a circular tube pan which is 12 inches in diameter and 5.50 inches deep. The circular pan which has a cylinder in the centre produces a round cake with a 3-inch diameter hole in the centre.

Total: 8 marks

a) Linda wants to use the rectangular cake for a birthday party. She needs to cut 5 large pieces (4" × 3") and at least 12 small pieces (2" × 2") for her guests (whole pieces only). Does she have enough cake for her guests? Support your answer with a scale drawing.

(2 marks)

Scale: 1 cm = 2 inches



5 pieces (4" × 3")
12 pieces (2" × 2")

5 pieces (4" × 3")
13 pieces (2" × 2")

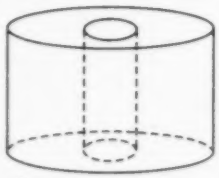
5 pieces (4" × 3")
14 pieces (2" × 2")

Yes, Linda has enough cake for her guests.

Question No. 1 continued

b) Linda wants to calculate the cost of making and decorating the circular cake. She will put a uniform layer of icing on the outside and inside walls, and the top of the cake. For decoration, a chocolate string will go on the top circumference of her cake, including enough to go around the centre opening. Calculate the total cost to make and decorate Linda's cake. Show your work.

Batter	**\$0.004 per in.^{3}**
Icing	**\$0.01 per in.^{2} (uniform layer)**
Chocolate string	**\$0.39 per ft. (sold in one foot lengths)**



(6 marks)

Batter:

$$\text{Volume} = \pi r^2 h - \pi r^2 h$$
$$= \pi(6)^2(5.50) - \pi(1.50)^2(5.50)$$
$$= 622.04 - 38.88$$
$$= 583.16 \text{ in.}^3$$

$$583.16 \text{ in.}^3 \times \$0.004 = \underline{\$2.33}$$

Icing:

$$\text{Surface area} = \overbrace{\pi r^2 - \pi r^2}^{\text{top}} + \overbrace{2\pi rh}^{\text{outside wall}} + \overbrace{2\pi rh}^{\text{inside wall}}$$
$$= \pi(6)^2 - \pi(1.50)^2 + 2\pi(6)(5.50) + 2\pi(1.50)(5.50)$$
$$= 106.03 + 207.35 + 51.84$$
$$= 365.22 \text{ in.}^2$$

$$365.22 \text{ in.}^2 \times \$0.01 = \underline{\$3.65}$$

Chocolate string:

$$\text{Circumference} = 2\pi(6) + 2\pi(1.50)$$
$$= 47.12 \text{ in.}$$
$$\frac{47.12 \text{ in.}}{12 \text{ in.}} = 3.93 \text{ ft.} \rightarrow \text{need } 4 \text{ ft.}$$

$$4 \text{ ft.} \times \$0.39 = \underline{\$1.56}$$

$$\text{Total cost of cake: } = \underline{\$7.54}$$

Question No. 1 continued

Scoring Rubric

General Performance Indicators		
Level 1—limited understanding		
1 mark **weak attempt: inappropriate strategy or no strategy** 1 criterion correct	**2 marks** **reasonable attempt: inappropriate strategy, major errors or omissions** 2 criteria correct	**3 marks** **reasonable attempt: inappropriate strategy but carried through correctly** 3 criteria correct
Level 2—good understanding		
4 marks **sound strategy with major errors** 4 criteria correct	**5 marks** **sound strategy with minor errors and some omissions** 5 criteria correct	**6 marks** **mostly complete with some omissions** 6 criteria correct
Level 3—exceptional understanding		
7 marks **complete, one minor error** 7 criteria correct	**8 marks** **complete and correct** 8 criteria correct	

Marker Note(s):

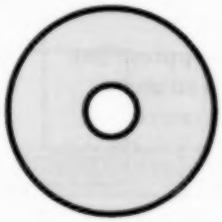
- *No mark deduction if the student adds taxes to the total cost.*
- *No mark deduction if the student makes assumption(s) (e.g., the cake will rise, the icing will effect the width of the cake), provided the calculations made are consistent with the assumption(s) made.*

Marking Key
1 mark for a scaled diagram in a)
1 mark for at least 12 small pieces (2" ×2") and 5 large pieces (4" ×3") of cake in a)
1 mark for 2 correct radii in b)
1 mark for volume of batter of 583.16 in.^{3} or answer based on student work in b)
1 mark for at least 2 of the 3 surface area calculations of icing in b)
1 mark for correct total surface area of icing of 365.22 in.^{2} in b)
1 mark for correct length of 4 ft. of chocolate string in b)
1 mark for total cost of cake in b) consistent with work in b)

Exemplar 1

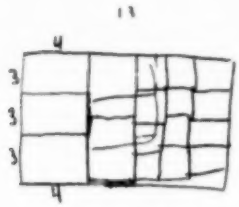
1. Linda has prepared two cakes. One is in a rectangular pan that measures 9 inches by 13 inches, with a depth of 3 inches. The other is in a circular tube pan which is 12 inches in diameter and 5.50 inches deep. The circular pan which has a cylinder in the centre produces a round cake with a 3-inch diameter hole in the centre.

Total: 8 marks



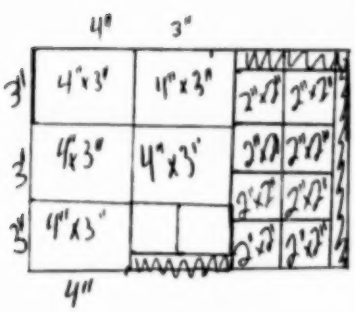
a) Linda wants to use the rectangular cake for a birthday party. She needs to cut 5 large pieces (4" × 3") and at least 12 small pieces (2" × 2") for her guests (whole pieces only). Does she have enough cake for her guests? Support your answer with a scale drawing.

(2 marks)



1cm = 2in

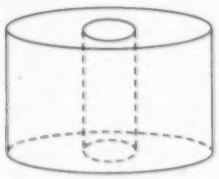
5(4"x3") and 8(2"x2")



Exemplar 1 continued

b) Linda wants to calculate the cost of making and decorating the circular cake. She will put a uniform layer of icing on the outside and inside walls, and the top of the cake. For decoration, a chocolate string will go on the top circumference of her cake, including enough to go around the centre opening. Calculate the total cost to make and decorate Linda's cake. Show your work.

Batter	\$0.004 per in.^{3}
Icing	\$0.01 per in.^{2} (uniform layer)
Chocolate string	\$0.39 per ft. (sold in one foot lengths)



(6 marks)

batter: $\pi r^2 h = \pi(6)^2(5.5)$
$= 622 - \pi(1.5)^2(5.5)$
$= 583.12\ in^3 \times \$0.004$
$= 584 \times \$0.004$ $\$2.34$

Chocolate string:

$2\pi R$
$C = 2\pi(6)$ 37.6 = 38 in
$C = 9.42$ = 10 in

$\frac{48\ in}{12} \times 0.39 = \$1.56$

Icing: Area = πr^2
outside: $2\pi(6) \times 5.5 = 207.35 = 208$
$\times 0.01 = \$2.08$
Top: $\pi r^2 = \pi(6^2) - \pi(.5)^2$
$= 106.02 \approx 107\ in^2 = \$1.07$
inside: $94.2 \times 5.5 = 51.81 = 52 = \$0.52$

Total = \$7.57

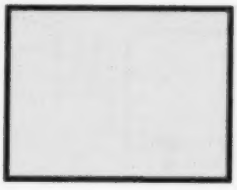
7 marks:

- 1 mark for a scaled diagram in a)
- 1 mark for 2 correct radii in b)
- 1 mark for volume of batter of 583.16 in.^{3} in b)
- 1 mark for at least 2 of the 3 surface area calculations of icing in b)
- 1 mark for correct total surface area of icing of 365.22 in.^{2} in b)
- 1 mark for correct length of 4 ft. of chocolate string in b)
- 1 mark for total cost of cake in b) consistent with work in b)

Exemplar 2

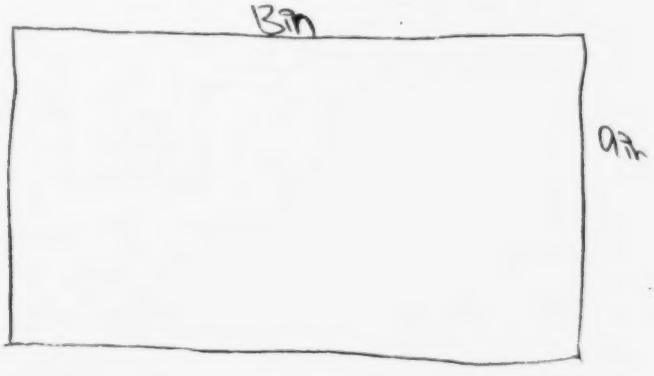
1. Linda has prepared two cakes. One is in a rectangular pan that measures 9 inches by 13 inches, with a depth of 3 inches. The other is in a circular tube pan which is 12 inches in diameter and 5.50 inches deep. The circular pan which has a cylinder in the centre produces a round cake with a 3-inch diameter hole in the centre.

Total: 8 marks



a) Linda wants to use the rectangular cake for a birthday party. She needs to cut 5 large pieces (4" × 3") and at least 12 small pieces (2" × 2") for her guests (whole pieces only). Does she have enough cake for her guests? Support your answer with a scale drawing.

(2 marks)



$5 \times (4 \times 3) = 60 in^2$ for larger pieces

$$\begin{array}{r} 113.09 \\ -\ 60.00 \\ \hline 53.09 \end{array}$$

2×2 piece $= 4 in^2$

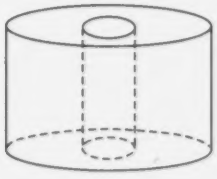
$53.09 \div 4 = 13.27$

13 pieces of 2×2 cake with .27 of an extra piece left.

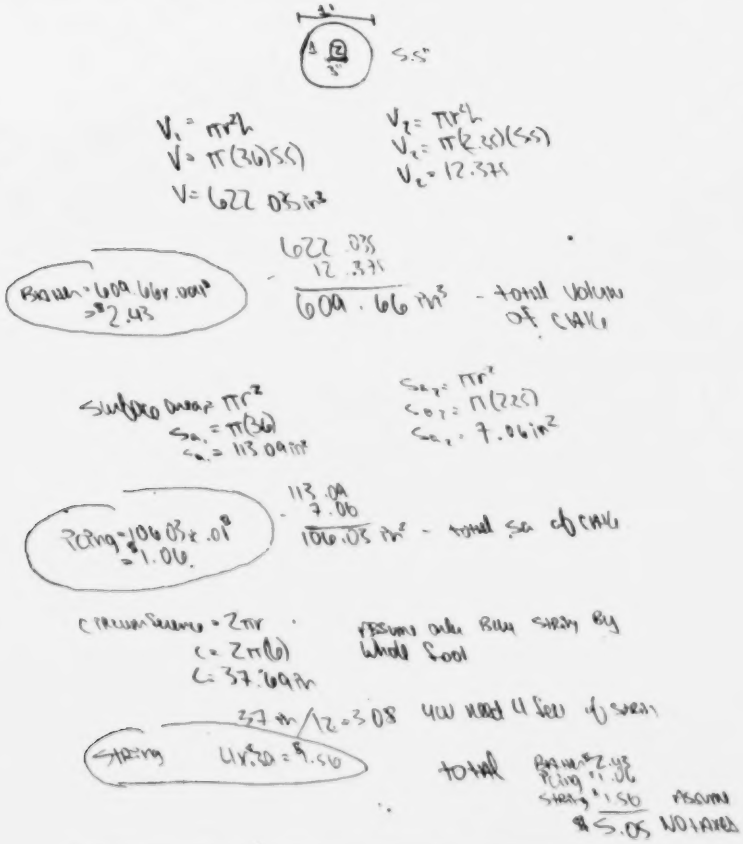
Exemplar 2 continued

b) Linda wants to calculate the cost of making and decorating the circular cake. She will put a uniform layer of icing on the outside and inside walls, and the top of the cake. For decoration, a chocolate string will go on the top circumference of her cake, including enough to go around the centre opening. Calculate the total cost to make and decorate Linda's cake. Show your work.

Batter	\$0.004 per in.^{3}
Icing	\$0.01 per in.^{2} (uniform layer)
Chocolate string	\$0.39 per ft. (sold in one foot lengths)



(6 marks)



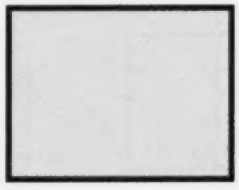
5 marks:

- 1 mark for 12 small pieces and 5 large pieces of cake in a) (consistent with error in calculation)
- 1 mark for 2 correct radii in b)
- 1 mark for volume of batter in b) (consistent with trivial error in b))
- 1 mark for correct length of 4 ft. of chocolate string in b)
- 1 mark for total cost of cake in b) consistent with work in b)

Exemplar 3

1. Linda has prepared two cakes. One is in a rectangular pan that measures 9 inches by 13 inches, with a depth of 3 inches. The other is in a circular tube pan which is 12 inches in diameter and 5.50 inches deep. The circular pan which has a cylinder in the centre produces a round cake with a 3-inch diameter hole in the centre.

Total: 8 marks



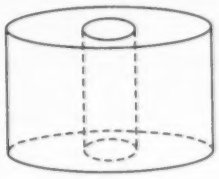
a) Linda wants to use the rectangular cake for a birthday party. She needs to cut 5 large pieces (4" × 3") and at least 12 small pieces (2" × 2") for her guests (whole pieces only). Does she have enough cake for her guests? Support your answer with a scale drawing.

(2 marks)

Exemplar 3 continued

b) Linda wants to calculate the cost of making and decorating the circular cake. She will put a uniform layer of icing on the outside and inside walls, and the top of the cake. For decoration, a chocolate string will go on the top circumference of her cake, including enough to go around the centre opening. Calculate the total cost to make and decorate Linda's cake. Show your work.

Batter	\$0.004 per in.^{3}
Icing	\$0.01 per in.^{2} (uniform layer)
Chocolate string	\$0.39 per ft. (sold in one foot lengths)



(6 marks)

r^2 $2\pi r$

Chocolate string

A $2\pi 6 = 37.7\ in^3$

A^2 $2\pi 1.5 = 9.4\ in^3$

$47.1\ in^3$

batter

$A = 2\pi 6in = 37.7\ in^3$

$A^2 = 2\pi 1.5 = 9.4\ in^3$

$A = 28.3\ in^3$

$28.3 \times 5\frac{1}{2} = 155.65\ in^3$

$155.65 in \times .004 = .62$

Icing

Top $A = 2\pi 6in = 37.7\ in^3$

A^2 $2\pi 1.5 = 9.4\ in^3$

$47.1\ in^3$

2 marks:

- 1 mark for 2 correct radii in b)
- 1 mark for correct length of 4 ft. of chocolate string in b)

Specific Outcome: H2 **Item Type: Open Response**

Inquiry Task Question No. 2 and Answer 1

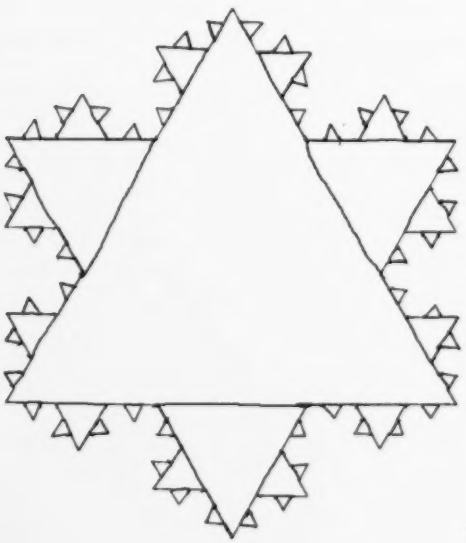
SEQUENCES

2. Create a fractal using the outside of the equilateral triangle below. Your fractal must always be created on the outside of the previous iteration.

Total: 10 marks

a) Draw your fractal to the 3rd iteration (inclusive) on the original shown below.

(2 marks)



b) Write specific directions to draw your fractal pattern.

(2 marks)

Divide each side into 3 equal parts. Using the centre piece on each side as your base, draw an equilateral triangle whose sides are one-third of the previous side. Repeat the above steps on every line segment of the new iteration.

Question No. 2 and Answer 1 continued

c) Complete the table for the first 4 iterations of your fractal. Assume that the original triangle has sides of length 6 cm.

(3 marks)

	Number of sides	Length of each side	Total Perimeter
original triangle	3	6 cm	18 cm

Iteration	Number of new sides	Length of each new side	Total Perimeter
1	12	2	24
2	48	$\frac{2}{3}$	32
3	192	$\frac{2}{9}$	42.67
4	768	$\frac{2}{27}$	56.89

d) What would the total perimeter of your fractal be after 6 iterations?

(1 mark)

Iteration	Number of new sides	Length of each new side	Total Perimeter
5	3072	$\frac{2}{81}$	75.85
6	12 288	$\frac{2}{243}$	101.14

e) What would happen to the perimeter of the fractal if the number of iterations increased indefinitely? Support your answer.

(2 marks)

The perimeter will continue to grow indefinitely because the sequence is:

$n\text{Min} = 0$

$$u(n) = u(n-1) \times \frac{4}{3}$$

$u(n\text{Min}) = \{18\}$

$t_{100} = 5.60 \times 10^{13}$

$t_{150} = 9.90 \times 10^{19}$

Inquiry Task Question No. 2 and Answer 2

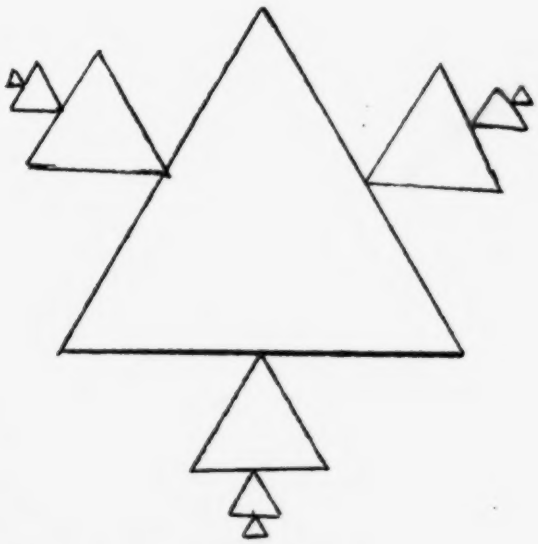
SEQUENCES

2. Create a fractal using the outside of the equilateral triangle below. Your fractal must always be created on the outside of the previous iteration.

Total: 10 marks

a) Draw your fractal to the 3rd iteration (inclusive) on the original shown below.

(2 marks)



b) Write specific directions to draw your fractal pattern.

(2 marks)

Find the midpoint of each side of the original triangle. Draw an equilateral triangle that has sides one-third the length of the original by attaching each new triangle to the midpoints on the original by its vertex. Find the midpoint of the side opposite the attached vertex.

Draw the next iteration which is an equilateral triangle with sides one-third the length of the previous iteration and attached at the outer most midpoint.

c) Complete the table for the first 4 iterations of your fractal. Assume that the original triangle has sides of length 6 cm.

(3 marks)

	Number of sides	Length of each side	Total Perimeter
original triangle	3	6 cm	18 cm

Iteration	Number of new sides	Length of each new side	Total Perimeter
1	9	2	36
2	9	$\frac{2}{3}$	42
3	9	$\frac{2}{9}$	44
4	9	$\frac{2}{27}$	44.67

d) What would the total perimeter of your fractal be after 6 iterations?

(1 mark)

Iteration	Number of new sides	Length of each new side	Total Perimeter
5	9	$\frac{2}{81}$	44.89
6	9	$\frac{2}{243}$	44.96

e) What would happen to the perimeter of the fractal if the number of iterations increased indefinitely? Support your answer.

(2 marks)

The total perimeter would eventually level off at about 45 cm. If you extend the table and follow the pattern the total perimeter gets closer to 45 cm.

Other answers are possible.

Question No. 2 continued

Scoring Rubric

General Performance Indicators			
Level 1—limited understanding			
1 mark **weak attempt: inappropriate strategy or no strategy** 1 criterion correct	**2 marks** **reasonable attempt: inappropriate strategy, major errors or omissions** 2 criteria correct	**3 marks** **reasonable attempt: inappropriate strategy but carried through correctly** 3 criteria correct	
Level 2—good understanding			
4 marks **sound strategy with major errors** 4 criteria correct	**5 marks** **sound strategy with minor errors** 5 criteria correct	**6 marks** **mostly complete with some omissions** 6 criteria correct	**7 marks** **almost complete and correct, major errors** 7 criteria correct
Level 3—exceptional understanding			
8 marks **complete, two minor errors, trivial errors** 8 criteria correct	**9 marks** **complete, one minor error** 9 criteria correct	**10 marks** **complete and correct** 10 criteria correct	

Marker Note(s):

- *There are many possible answers for this question.*

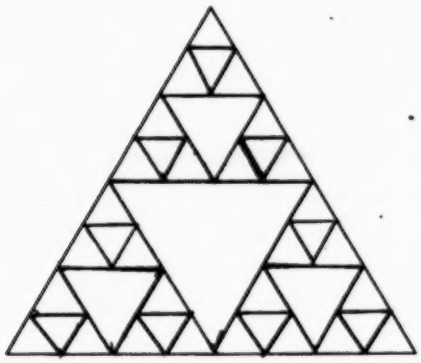
Marking Key
1 mark for drawing a fractal on the outside of the original triangle in a)
1 mark for drawing 3rd iteration in a)
1 mark for directions stating where to begin in b)
1 mark for directions stating what to build in b)
1 mark for correct number of new sides in c) consistent with work in a)
1 mark for correct length of sides in c)
1 mark for correct total perimeter in c)
1 mark for total perimeter of fractal after 6 iterations in d)
1 mark for correct answer in e)
1 mark for correct support in e)

2. Create a fractal using the outside of the equilateral triangle below. Your fractal must always be created on the outside of the previous iteration.

Total:
10 marks

a) Draw your fractal to the 3rd iteration (inclusive) on the original shown below.

(2 marks)



b) Write specific directions to draw your fractal pattern.

(2 marks)

(1) Draw a line to connect each of the midpoints of the triangle.

(2) In all the new triangles created, take the ones that point the same way as the original, (in this case, Base at Bottom, point at top) and then do step (1) to all the new midpoints.

(3) continue repeating steps (1) & (2), two more times, then you will have a Fractal with 3 iterations.

c) Complete the table for the first 4 iterations of your fractal. Assume that the original triangle has sides of length 6 cm.

(3 marks)

	Number of sides	Length of each side	Total Perimeter
original triangle	3	6 cm	18 cm

I will assume this perimeter of is the new triangle

Iteration	Number of new sides	Length of each new side	Total Perimeter
1	3	3	9
2	9	1.5	4.50
3	27	.75	2.25
4	81	.38	1.14

→ $18 \div 2 = 9 \div 2 = 4.50 \div 2 = 2.25 \div 2 = 1.14$

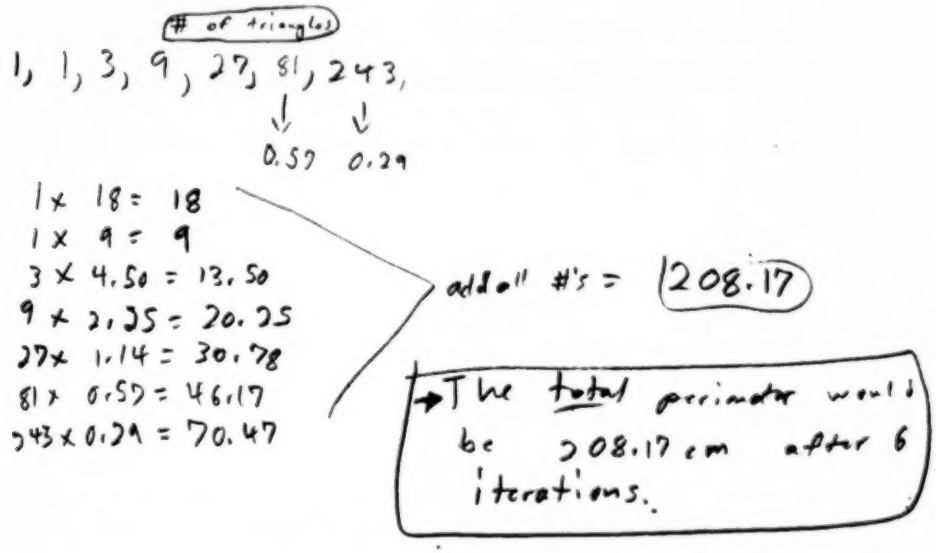
→ $6 \div 2 = 3 \div 2 = 1.5 \div 2 = .75 \div 2 = .38$

→ $3 \times 3 = 9 \times 3 = 27 \times 3 = 81$

Exemplar 1 continued

d) What would the total perimeter of your fractal be after 6 iterations?

(1 mark)



e) What would happen to the perimeter of the fractal if the number of iterations increased indefinitely? Support your answer.

(2 marks)

The perimeter would increase progressively faster with each iteration.

7 marks:

- 1 mark for drawing 3rd iteration in a)
- 1 mark for directions stating where to begin in b)
- 1 mark for directions stating what to build in b)
- 1 mark for correct number of new sides based on assumption in c)
- 1 mark for correct length of sides based on assumption in c)
- 1 mark for correct total perimeter based on assumption in c)
- 1 mark for answer in e) consistent with error in d)

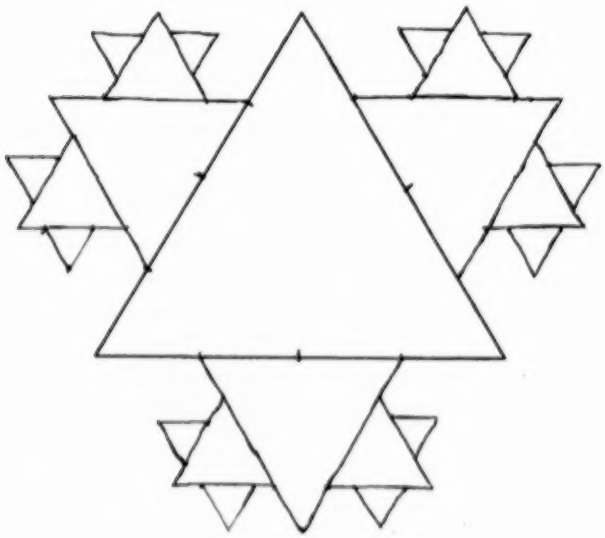
Exemplar 2

2. Create a fractal using the outside of the equilateral triangle below. Your fractal must always be created on the outside of the previous iteration.

Total:
10 marks

a) Draw your fractal to the 3rd iteration (inclusive) on the original shown below.

(2 marks)



Exemplar 2 continued

b) Write specific directions to draw your fractal pattern.

(2 marks)

Start at big triangle. Make 3cm triangles in middle of each side. Make 1.5cm triangles in middle of each of those triangles. Then make .75cm triangles of each one of those sides. All angles should be 60°.

c) Complete the table for the first 4 iterations of your fractal. Assume that the original triangle has sides of length 6 cm.

(3 marks)

	Number of sides	Length of each side	Total Perimeter
original triangle	3	6 cm	18 cm

Iteration	Number of new sides	Length of each new side	Total Perimeter
1	12	3	36
2	30	1.5	45
3	66	.75	49.5
4	138	.375	51.75
5			52.875
6			53.4375

Exemplar 2 continued

d) What would the total perimeter of your fractal be after 6 iterations?

(1 mark)

The total perimeter after 6 iterations would be 53.4375.

e) What would happen to the perimeter of the fractal if the number of iterations increased indefinitely? Support your answer.

(2 marks)

Would keep going up but would never go over 60.

7 marks:

- 1 mark for drawing a fractal on the outside of the original triangle in a)
- 1 mark for drawing 3rd iteration in a)
- 1 mark for directions stating where to begin in b)
- 1 mark for stating what to build in b)
- 1 mark for correct length of sides in c)
- 1 mark for answer in d) consistent with error in c)
- 1 mark for answer in e) consistent with error in c)

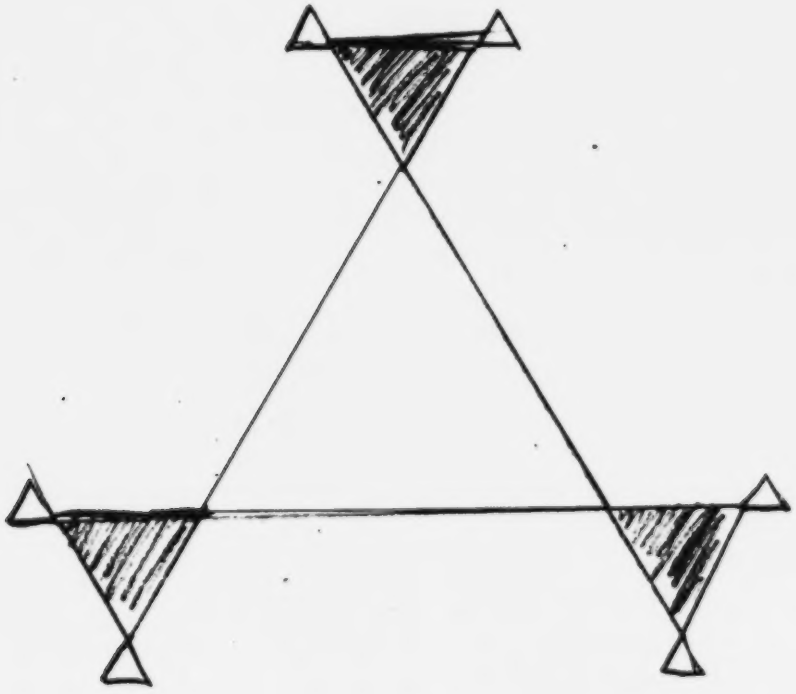
Exemplar 3

2. Create a fractal using the outside of the equilateral triangle below. Your fractal must always be created on the outside of the previous iteration.

Total:
10 marks

a) Draw your fractal to the 3rd iteration (inclusive) on the original shown below.

(2 marks)



b) Write specific directions to draw your fractal pattern.

(2 marks)

TAKE your ruler and put up to any of the lines start your measurement at 2 and end at 8. Then draw a line from 1 to 10. Do this three times and connect the end's that need to be 2cm. Then you are done.

c) Complete the table for the first 4 iterations of your fractal. Assume that the original triangle has sides of length 6 cm.

(3 marks)

	Number of sides	Length of each side	Total Perimeter
original triangle	3	6 cm	18 cm

1.67

Iteration	Number of new sides	Length of each new side	Total Perimeter
1	12	10	120
2	96	16.67	800.16
3	192	27.78	5333.76
4	768	46.40	35635.2
6	12288	129.317	1590312.96

Exemplar 3 continued

d) What would the total perimeter of your fractal be after 6 iterations?

(1 mark)

1590312.96 cm

e) What would happen to the perimeter of the fractal if the number of iterations increased indefinitely? Support your answer.

(2 marks)

The new numbers would keep getting smaller and smaller, and so, the perimeter would keep getting larger and larger

3 marks:

- 1-mark for drawing a fractal on the outside of the original triangle in a)
- 1 mark for directions stating where to begin in b)
- 1 mark for total perimeter of fractal after 6 iterations in d) consistent with error in c)

Appendices

APPENDIX A

Table of Specific Outcome Match and Item Type

Selected-response items				
Question No.	Key	Unit	Specific Outcome	Mark
1	B	A	2	1
2	C	A	1	1
3	B	B	1	1
4	D	B	2	1
5	A	C	1	1
6	D	C	2	1
7	B	D	2	1
8	A	D	3	1
9	D	E	2	1

Restricted-response items			
Question No.	Unit	Specific Outcome	Mark
10	A	2	3
14	C	2	4
15	C	3	4
19	E	1, 2	2
22	G	1, 2	3

Restricted-response with explanation items			
Question No.	Unit	Specific Outcome	Mark
11	A	1, 2	4
13	B	3	2
16	D	1	2
17	D	2	2
18	D	4, 5	2
20	E	2	4
21	E	3	3

Open-response items			
Question No.	Unit	Specific Outcome	Mark
12	B	3	5
23	G	1, 2	4
Inquiry 1	F	1, 2, 3	8
Inquiry 2	H	2	10

APPENDIX B

Generating Student Profiles

Profile of Test Score by Question Type

Item Type	Test Items	Total	÷ Maximum	× 100	= %
Selected-response	1 to 9: ____		9		
Restricted-response	10 ____, 14 ____, 15 ____, 19 ____, 22 ____		16		
Restricted-response with explanation	11 ____, 13 ____, 16 ____, 17 ____, 18 ____, 20 ____, 21 ____		19		
Open-response	12 ____, 23 ____, Inquiry 1 ____, Inquiry 2 ____		27		

Profile of Test Score by Curriculum Unit

Unit	Test Items	Total	÷ Maximum	× 100	= %
Matrices	1 ____, 2 ____, 10 ____, 11 ____		9		
Vectors	3 ____, 4 ____, 12 ____, 13 ____		9		
Personal Finance	5 ____, 6 ____, 14 ____, 15 ____		10		
Probability	7 ____, 8 ____, 16 ____, 17 ____, 18 ____		8		
Variability and Statistical Analysis	9 ____, 19 ____, 20 ____, 21 ____		10		
Design and Measurement	Inquiry 1 ____		8		
Periodic Functions	22 ____, 23 ____		7		
Sequences	Inquiry 2 ____		10		

APPENDIX C—Sheets for Marking the Inquiry Tasks

Inquiry Task 1: Design and Measurement		Booklet Numbers				
a)	1 mark for a scaled diagram					
	1 mark for at least 12 small pieces (2" × 2") and 5 large pieces (4" × 3") of cake					
b)	1 mark for 2 correct radii					
	1 mark for volume of batter of 583.16 $in.^3$ or answer based on student work					
	1 mark for at least 2 of the 3 surface area calculations of icing					
	1 mark for correct total surface area of icing of 365.22 $in.^2$					
	1 mark for correct length of 4 ft. of chocolate string					
	1 mark for total cost of cake consistent with work in b)					
	Totals					

Inquiry Task 1: Design and Measurement		Booklet Numbers				
a)	1 mark for a scaled diagram					
	1 mark for at least 12 small pieces (2" × 2") and 5 large pieces (4" × 3") of cake					
b)	1 mark for 2 correct radii					
	1 mark for volume of batter of 583.16 $in.^3$ or answer based on student work					
	1 mark for at least 2 of the 3 surface area calculations of icing					
	1 mark for correct total surface area of icing of 365.22 $in.^2$					
	1 mark for correct length of 4 ft. of chocolate string					
	1 mark for total cost of cake consistent with work in b)					
	Totals					

Use check marks (✓) to tally students' marks on the question.

Inquiry Task 2: Sequences		Booklet Numbers				
a)	1 mark for drawing a fractal on the outside of the original triangle					
	1 mark for drawing 3rd iteration					
b)	1 mark for directions stating where to begin					
	1 mark for directions stating what to build					
c)	1 mark for correct number of new sides consistent with work in a)					
	1 mark for correct length of sides					
	1 mark for correct total perimeter					
d)	1 mark for total perimeter of fractal after 6 iterations					
e)	1 mark for correct answer					
	1 mark for correct support					
	Totals					

Inquiry Task 2: Sequences		Booklet Numbers				
a)	1 mark for drawing a fractal on the outside of the original triangle					
	1 mark for drawing 3rd iteration					
b)	1 mark for directions stating where to begin					
	1 mark for directions stating what to build					
c)	1 mark for correct number of new sides consistent with work in a)					
	1 mark for correct length of sides					
	1 mark for correct total perimeter					
d)	1 mark for total perimeter of fractal after 6 iterations					
e)	1 mark for correct answer					
	1 mark for correct support					
	Totals					

Use check marks (✓) to tally students' marks on the question.

APPENDIX D

Irregularities in Standards Tests

A Guide for Local Marking

The *Administration Manual for Supervising Teachers* and the *Policies and Procedures for Standards Tests* are distributed to teachers and administrators to ensure consistency in the administration of standards tests. These documents deal with the issues of test material security and the department's policy regarding adaptations and exemptions.

During the marking of standards tests, markers have occasionally encountered test booklets in which there have been irregularities. The following list provides examples of such irregularities, and is not intended to be exhaustive:

- Completely different penmanship in the same booklet
- Incoherent work with correct answer(s)
- Notes from a teacher indicating how they have assisted students during the test administration
- Student offering that they received teacher assistance for a question
- Student submitting work on unauthorized paper
- Evidence of plagiarism or cheating

If a student's mark on the test is 0% because he/she left the whole test booklet blank or answered with a combination of non-responses and inappropriate responses, please complete an *Irregular Test Paper Report* to confirm that the result is accurate (i.e., the student was not, in fact, absent or exempted).

Please note that student comments or responses indicating that the student may be at personal risk of being harmed or of harming others are personal safety issues. This type of student response requires an immediate and appropriate follow-up action at the school level. In this case, please ensure the department is made aware that a follow-up has taken place by completing an *Irregular Test Paper Report*.

Except in the case of cheating or plagiarism where the result is a standards test mark of 0%, it is the responsibility of the divisions/schools to determine how they will proceed with irregularities. Once an irregularity has been confirmed, the marker prepares an *Irregular Test Paper Report* documenting the situation, the people contacted, and the follow-up. The original copy of this report is to be retained by the local jurisdiction and a copy is to be sent to the Instruction, Curriculum and Assessment Branch along with all other test materials.

Irregular Test Paper Report

Test: _____

Date marked: _____

Booklet ID No.: _____

Problem noted: _____

_____

_____

_____

_____

_____

Question(s) affected: _____

_____

_____

Action taken or rationale for assigning marks: _____

_____

_____

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_____

_____

_____

Follow-up: _____

_____

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_____

Decision: _____

_____

_____

_____

_____

_____

_____

Marker's Signature: _____

Principal's Signature: _____

For Department Use Only—After Marking Complete

Consultant: _____

Date: _____